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Understanding Public Debate on Nanotechnologies

Options for Framing Public Policy

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A Report from the European Commission Services

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1. Introduction: Understanding Public Debate on Nanotechnologies Options for Framing Public Policy

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1 Dr. René von Schomberg is based at DG Research of the European Commission. This working paper is written for the publication series of the Governance and Ethics Unit of DG Research. The views expressed here are those of the author and may not in any circumstances be regarded as stating an official position of the European Commission.

This publication consists of a series of research articles on the nature of public debate on nanosciences and nanotechnologies, and the ways in which deliberative approaches could lead to better governance of these technologies. The authors of these articles were involved (as coordinators or participants) in a number of now completed European Commission-funded 'Science in Society' projects.

Of these, the project FRAMINGNANO involved the development of a governance plan for nanotechnologies. NANOCAP was a capacity building exercise, through which European Trade Unions and Environmental NGOs adopted resolutions and positions on the governance of nanotechnologies. The DEEPEN project elaborated the ethics of nanotechnologies and investigated the narratives which underlie public discourse, while NANOPLAT proposed a new deliberative platform for consumers of nanotechnologically-enabled products and, in the course of doing this, evaluated a number of different approaches to deliberation [2].

This research was developed in response to the Science in Society Programme of Work strategy, which calls for a deliberative approach to responsible development of nanosciences and nanotechnologies. Such an approach implies an inclusive governance of nanotechnologies – one based on broad stakeholder involvement and early public intervention in research and development, and ultimately leading to well-informed research and policy agendas which guide and promote the responsible development of nanotechnology.

While it draws on research from these four projects, this volume is not simply an overview of their major conclusions. The authors had a mandate to discuss the nature of public debate and involvement, and how it might become part and parcel of good governance of the nanosciences and nanotechnologies. The European Commission is committed to promoting public debate on nanotechnology, and believes that public policies need to be responsive to evolving public opinion. This volume, then, aims to serve as background material and as input into ongoing debates – both at national and European levels – on these issues.

The responsible development of nanosciences and nanotechnologies: A historical perspective

The formation of public opinion on new technologies is not a historically or geographically isolated process; rather, it is inevitably linked to prior (national and international) debate on similar topics. Ideally, such debates should enable a learning process – one that allows for the fact that public opinion forms within particular cultures and political systems. It is therefore not surprising that, in the case of nanotechnologies, the nature of public debate and its role in the policy making process is articulated against a background of previous discussion of the introduction of new technologies (such as biotechnology), or that specific national experiences with those technologies become important. In particular, the introduction of genetically modified organisms (GMOs) into the environment is a frequent reference point within Europe (whereas more frequently absent in such debates in the USA).

This historical development of policy frameworks can be followed through the ways in which terms are used and defined: initially, definitions are often determined by the use of analogies which, in the initial stages of the policy process, serve to 'normalise' new phenomena. In a number of countries, for instance, GMOs were initially regulated through laws which deal with toxic substances. Subsequently such analogies tend to lose their force as scientific insights on the technology grows and distinct regulatory responses can be made. GMOs, for example, eventually became internationally defined as 'potentially hazardous', and, in the European Union, a case by case approach was adopted under new forms of precautionary regulation. This framework was developed over a period of decades, and thereby took into account the ever-widening realm in which GMOs could have effects (developing from an exclusive focus on direct effects to eventually include indirect and long-term effects). It is not, however, solely the scientific validity of analogies which determines definitions and policy: public interest also plays an important role. Carbon dioxide, for instance, has changed from being viewed as a gas essential to life on earth to being a 'pollutant'. (The latest iteration of this evolution came just prior to the Copenhagen summit on climate change in December 2009, when the American Environmental Protection Agency defined greenhouse gases as a "threat to *public health*" – a definition which has important implications for future policy measures.)

In the case of nanotechnology policy, then, it seems likely that we are still in the initial phases of development. There are not, so far, any internationally agreed definitions relating to the technology (despite repeated announcements of their imminence), and nanoparticles continue to be defined as "chemical substances" under the European regulatory framework REACH. (Analogies are also made with asbestos, as a way to grasp hold of possible environmental and human health effects, but these are contested. There is no certainty that they will become the definitive way to frame risk assessments.) To cite one topical example, nanotechnology in food will not start its public and policy life with a historically blank canvas but will be defined as a 'novel food' under a proposal for renewing the Novel Foods regulation. (The Novel Foods regulation came into existence in the 1990's with foods containing or consisting of GMO's in mind). Recent proposals for renewing regulation on food additives (after a first reading of the European Commission's proposal in the European Parliament in April 2009) have made this the first piece of regulation to include explicit reference to nanotechnology.

Public debate that articulates particular interests and scientific debate on the validity of analogical approaches to nanotechnologies will inevitably continue to shape the ways in which nanotechnologies are addressed in regulation and policy. But the governance of the technology, as well as debate around it, has to be seen within its historical context. How did stakeholders behave in previous cases, and what can we learn from these cases with regard

2 See the website of the respective projects for extensive coverage:
DEEPEN: http://www.geography.dur.ac.uk/projects/deepen/Home;
FRAMINGNANO: http://www.framingnano.eu;
NANOPLAT: http://nanoplat.org;
NANOCAP: http:// www.nanocap.eu

to nanotechnology? One answer to this question might point to a learning process around the governance of new technologies, and the development of a consensus that early involvement of both stakeholders and the broader public is of the utmost importance. The European Commission has responded to this with its adoption of a European strategy and action plan on nanotechnologies, which addresses topics from research needs to regulatory responses and ethical issues to the need for international dialogue. This strategy above all emphasises the "safe, integrated and responsible" development of nanosciences and nanotechnologies – something which the DEEPEN consortium (see chapter 2 and 3) has drawn upon in articulating how 'responsible development' might take its course within deliberative fora.

The Code of Conduct for the responsible development of nanosciences and nanotechnologies

Policy development treads a fine line: governments should not make the mistake of responding too early to a technology, and failing to adequately address its nature, or of acting too late, and thereby missing the opportunity to intervene. A good governance approach, then, might be one which allows flexibility in responding to new developments. After a regulatory review in 2008, the European Commission came to the conclusion that there is no immediate need for new legislation on nanotechnology, and that adequate responses can be developed – especially with regard to risk assessment – by adopting measure, guidelines etc under existing legislation [3].

While, in the absence of a clear consensus on definitions, the preparation of new nano-specific measures will be difficult, and although there continues to be significant scientific uncertainty on the nature of the risks involved, good governance will have to go beyond policy making focused on legislative action. The power of governments is arguably limited by their dependence on the insights and cooperation of societal actors when it comes to the governance of new technologies: the development of a code of conduct, then, is one of their few options for intervening in a timely and responsible manner. The Commission states in the second implementation report on the action plan for Nanotechnologies that "its effective implementation requires an efficient structure and coordination, and regular consultation with the Member States and all stakeholders" [4]. Similarly, legislators are dependent on scientists' proactive involvement in communicating possible risks of nanomaterials, and must steer clear of any legislative actions which might restrict scientific communication and reporting on risk. The ideal is a situation in which all the actors involved communicate and collaborate. The philosophy behind the European Commission's code of conduct, then, is precisely to support and promote active and inclusive governance and communication. It assigns responsibilities to actors beyond governments, and promotes these actors' active involvement against the backdrop of a set of basic and widely shared principles of governance and ethics. Through codes of conduct, governments can allocate tasks and roles to all actors involved in technological development, thereby organising collective responsibility for the field [5]. Similarly, Mantovani *et al* (chapter 4) propose a governance plan which both makes use of existing governance structures and suggests new ones, as well as proposing how they should relate to each other.

The EC Code of Conduct also views Member States of the European Union as responsible actors, and invites them to use the Code as an instrument to encourage dialogue amongst "policy makers, researchers, industry, ethics committees, civil society organisations and society at large" (recommendation number 8 to Member States, cited on page 6 of the Commission's recommendation, see footnote reference 3), as well as to share experiences and to review the Code at the European level on a biannual basis [6].

Applying the precautionary principle

As argued above, the responsible development of new technologies must be viewed in its historical context. Some governance principles have been inherited from previous cases: this is particularly notable for the application of the precautionary principle to the field of nanosciences and nanotechnologies. This principle is firmly embedded in European policy, and is enshrined in the 1992 Maastricht Treaty as one of the three principles upon which all environmental policy is based. It has been progressively applied to other fields of policy, including food safety, trade and research.

The principle runs through legislation that is applied to nanotechnologies, for example in the 'No data, no market' principle of the REACH directive for chemical substances, or the pre-market reviews required by the Novel Foods regulation. More generally, within the context of the general principles and requirements of the European food law it is acknowledges that "scientific risk assessment alone cannot provide the full basis for risk management decisions" [7] – leaving open the possibility of risk management decision making partly based on ethical principles or particular consumer interests.

3 However, the European Commission will give follow-up to the request of the European Parliament to review all relevant legislation within the next two years, to ensure safety over the whole life cycle of nanomaterials in products.

4 Commission of the European Communities (2009) Communication from the commission to the council, the European Parliament and the European Economic and Social Committee. Nanosciences and Nanotechnologies: An action plan for Europe 2005-2009. Second Implementation Report 2007-2009, Brussels, 29.10.2009, COM (2009) 607 final (citation on page 10).

5 Commission of the European Communities (2008), Commission Recommendation of 7 February 2008, on a code of conduct for responsible nanosciences and nanotechnologies research, 7 february 2008.

6 The European Commission supports the definition and development of a framework enabling the successful integration and implementation, at European level and beyond, of the Code of Conduct for responsible nanosciences and nanotechnologies Research through a financial contribution to the NANOCODE project.

7 Regulation (EC) no 178/2002 of the European Parliament and of the Council of 28 January2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety states "(19)it is recognised that scientific risk assessment alone cannot, in some cases, provide all the information on which a risk management decision should be based, and that other factors relevant to the matter under consideration should legitimately be taken into account including societal, economic, traditional, ethical and environmental factors and the feasibility of controls".

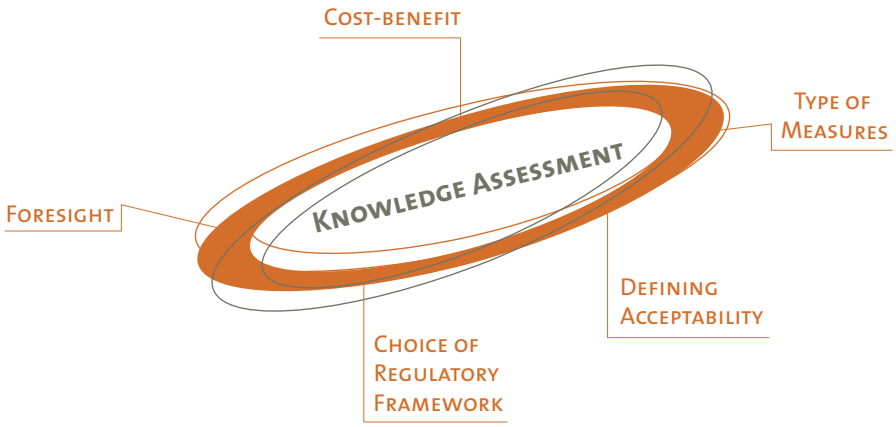
In the EC Code of Conduct, the principle appears in the call for risk assessment before any public funding of research (a strategy currently applied in the 7th Framework Programme for research). Rather than stifling research and innovation, the precautionary principle acts within the Code of Conduct as a focus for action, in that it calls for funding for the development of risk methodologies, the execution of risk research, and the active identification of knowledge gaps. Under the Framework Programme, for example, an observatory has been funded to create a network for the communication and monitoring of risk. The NANOCAP consortium – featuring deliberation among European NGO's and Trade Unions – similarly made a number of suggestions of further building blocks for a precautionary approach (see Chapter 6).

Outlook: Deliberative approaches to the policy making process

Deliberative approaches to nanotechnology should not be reduced to a public debate exercise. While such debate is important, the responsible development of nanosciences and technologies also requires deliberative approaches to the technology assessment mechanisms of the policy process (such as cost-benefit analysis, foresight exercises and risk assessments). Scientific and public controversies often remain inconclusive when there is a lack of consensus on the normative (ethical) basis of such assessment mechanisms. In the development of nanotechnologies, there is not yet a shared understanding of how we might define the acceptability of possible risks, or of how we would weigh them against possible benefits.

Moreover, in the context of scientific uncertainty and production of knowledge by a range of different actors, we need knowledge assessment mechanisms which will assess the quality of available knowledge for the policy process. We are currently forced to act upon developments while at the same time being uncertain about the quality and comprehensiveness of the available scientific knowledge and the status of public consensus. A deliberative approach to the policy-making process would complement and connect with deliberative mechanisms outside policy (on which, notably, the FRAMINGNANO consortium focused, see chapter 4). The outcomes of ongoing knowledge assessment [8] should feed into other assessment mechanisms and into deliberation on the acceptability of risk, the choice of regulatory frameworks or the measures taken under those frameworks. Knowledge assessment following the result of foresight exercises would then be important tools in setting out arguments for the necessity and nature of future legislative actions.

Figure 1: A non-directional cycle of assessment mechanisms within the policy making process fed by knowledge assessment processes



The NANOPLAT project similarly developed a case that a more permanent form of deliberation is necessary for enabling an ongoing process of collective responsibility. The consortium developed an online tool for the deliberation on consumer products, which might serve as a starting point for this ongoing process (see chapter 5). The argument of the NANOPLAT consortium for the necessity for permanent forms of deliberation is also reflected in the recent Communication of the European Commission [9]:

> "The existence of diverse forums indicates a need to monitor the debates at national, European and international levels, for instance with support from future FP7 activities, in order consistently to convey messages from public debates to policy makers" (cited on page 6)

and

> "Implementing a more direct, focused and continuous societal dialogue; and monitoringpublic opinion and issues related to consumer, environmental and worker protection" (cited from the conclusions of the Communication)

8 In accordance with the procedures developed in: Von Schomberg, René (2007), From the Ethics of Technology towards and Ethics of Knowledge Assessment, Working document of the European Commission Services and Von Schomberg, René, Angela Guimaraes Pereira and Silvio Funtowicz (2005), Deliberating Foresight Knowledge for Policy and Foresight Knowledge Assessment, Working document of the European Commission Services.

9 Commission of the European Communities (2009). Communication from the Commission to the Council, the European Parliament and the European Economic and Social Committee. Nanosciences and Nanotechnologies: An action plan for Europe 2005-2009. Second Implementation Report 2007-2009, Brussels, 29.10.2009, COM (2009) 607 final.

Any such discussions, however, also need to take into account the sheer scale of the numbers of nanomaterials expected to hit the market: J. Choi et al (2009) calculated that, merely for a 190 nanomaterials currently in production, the cost of risk assessment would amount to between $249 million(with optimistic assumptions about hazards) and $1,2 billion (in case of an approach consistent with the precautionary principle and this would take 34-53 years to fully implement) [10]. If a case for case approach consistent with the precautionary principle is taken, the capacity of regulatory bodies and the feasibility of control will soon become highly questionable given a likely flood of new nanomaterials. The framing of public policy will, yet again, be dependent on the ways that public interests and scientific insights are articulated in the years to come. This volume can be seen as a contribution to that process of articulation.

10 Choi, J. et al 2009. "The Impact of Toxicity Testing Costs on Nanomaterial Regulation," *Environmental Science and Technology*.

2. Narrative and Public Engagement: Some findings from the DEEPEN project [1]

Phil Macnaghten,
Sarah Davies and Matthew Kearnes

1 The DEEPEN (Deepening Ethical Engagement and Participation with Emerging Nanotechnologies) project was a three-year (2006-2009) research project funded by the European Commission's Framework Programme 6. The project was coordinated by Durham University, UK (Phil Macnaghten, Matthew Kearnes and Sarah Davies) and hosted by the Institute of Hazard and Risk Research (IHRR) in the Department of Geography. Project partners were researchers based at Darmstadt University of Technology, Germany (Alfred Nordmann and Arianna Ferrari), the Centre for Social Studies at the University of Coimbra, Portugal (João Nunes, Marisa Matias, Ângela Marques Filipe and Antonio Carvalho), and the University of Twente, Netherlands (Arie Rip and Clare Shelley-Egan). In writing this essay the authors wish to acknowledge productive interactions with the entire DEEPEN project team and their input into this work. See: http://www.geography.dur.ac.uk/projects/deepen/Home
See:http://www.dius.gov.uk/news_and_speeches/speeches/past_ministers/ian_pearson/nanotechnologies

Over the past decade, a policy and media debate about nanoscience and nanotechnologies has emerged. Their unprecedented economic and social potential has been reported, with, as a Lloyds report noted, potential applications in:

> transport, manufacturing, biomedicine, sensors, environmental management, food technology, information and communications technology, materials, textiles, sports equipment, cosmetics, skin care and defence, though this list is by no means exhaustive. (Lloyds 2007).

For their advocates, nanotechnologies could inaugurate a new industrial revolution (Roco and Bainbridge 2003; 2005). However, at the same time those with concerns about the technology are becoming more vocal. While some anxieties tend to be dismissed as science fiction – in particular visions of 'grey goo' and self-replicating nanobots running out of control (Drexler 1986; Joy 2000) – others are harder to set aside. Policy debate is increasingly focusing on the potential toxicity of nanoparticles and carbon nanotubes and their unknown and potentially hazardous impacts on the environment and human health (The Economist 2007; Poland et al 2008; Royal Commission on Environmental Pollution 2008; Which? 2008).

As UK government minister Ian Pearson noted in a 2008 speech, there is much at stake. Nanotechnology's development, he suggested, is "an ethical as well as a scientific question, and the public's voice should be heard in answering it".[2] In practice, policy on nanotechnology has pre-empted his comment. Since its inception in European and national research programmes, scientific research on nanotechnology has been accompanied by interest in characterising its ethical implications, understanding public responses to it, and making its governance more robust.

Such concerns, and a determination to learn from mistakes in handling recent public scientific controversies (exemplified in the UK by GM crops), have led to various initiatives aimed at the responsible development of nanotechnology (Defra 2006; Dupont 2007; European Commission 2007). Traditionally it has been assumed that technological innovation should proceed according to its own logic of assumed social benefit, relatively untainted by matters of ethics, democracy or social norms, and find its eventual acceptance or rejection in the market place. However, society has rarely accepted such claims of inevitable benefit without question, not least due to a range of contemporary experiences of technological controversy and scientific mishap arising from unforeseen consequences of scientific advance, ranging from thalidomide and BSE to endocrine disruptors and chlorofluorocarbons. Part of the policy response to such critique has been to promote dialogue models of public engagement, starting with a prescient 2000 report from the UK House of Lords Select Committee on Science and Technology and its call for more open, two way, exploratory and participatory forms of public engagement (House of Lords 2000). The appeal for more proactive involvement and deliberation in debates about the social and ethical dimensions of science and technology is now commonplace in policy papers and reports (see Department of Trade and Industry 2000; European Commission

2004; HM Treasury/DTI/DfES, 2004; Royal Commission of Environment and Pollution 1998) with nanotechnology presented as the current focus (Kearnes et al. 2006; Wood et al. 2003, 2007).

Yet the challenges involved in developing such 'anticipatory' governance are far from inconsiderable. Most people are unfamiliar with nanotechnology, and have little to no factual knowledge of what it is or can be. The majority of nanotechnologies remain at an early or pre-market stage of development, existing largely in terms of their future-oriented promises, and experts agree that there is considerable uncertainty about the kinds of environmental and toxicological effects that might be expected. And nanotechnologies are not only unbelievably small, operating at dimensions of roughly 1 to 100 nanometres, but also tend to operate in ways that are fundamentally beyond human action, perception and causal control – creating a unique challenge for understanding and directing their development.

The move towards the 'responsible development' of nanotechnology, then, offers a key opportunity to develop a science that is explicitly and self-consciously in step with society, alongside new challenges to this development. Current efforts in ethical analysis, public engagement, and new forms of governance are impressive: for the first time, there is a public and policy debate on a technology in its nascent stages. But this debate requires continual rethinking – indeed, one of the key findings from the DEEPEN (Deepening Ethical Engagement and Participation with Emerging Nanotechnologies) project was that in many ways it needs to be entirely reconfigured (see Davies, Macnaghten and Kearnes 2009).

In this essay we discuss some aspects of this reconfiguration, in particular with regard to the role that public engagement plays in the new governance of science. After discussing some of the background on public engagement with nanotechnology, we move on to describe key findings from our own interventions with laypeople, suggesting that lay hopes and anxieties around technology can be understood as being structured by five key narratives. Reading public views on nanotechnology in this way has, we suggest, a number of important implications. In particular it highlights the complexity of public 'attitudes' or perceptions – leading to a need for matching sophistication in the ways in which social scientists and policymakers seek to map the views of laypeople and to engage in practices of public deliberation and participation. We sum up these implications through a set of four key recommendations:

1. Understand the complexity of public 'attitudes';
2. Engage with enduring public narratives;
3. Acknowledge that public engagement is difficult;
4. Be innovative in engagement practices.

2 See:http://www.dius.gov.uk/news_and_speeches/speeches/past_ministers/ian_pearson nanotechnologies

Nanotechnology and the public

One of the implications of the anticipatory or deliberative turn in technological governance is that it reinforces the need to understand and characterise better the public, its perceptions of novel technology, and, crucially, the factors that structure and underpin public attitudes and responses. In recent years a body of work has thus emerged which has attempted to map the understandings, enthusiasms and concerns of lay publics about nanotechnology – a body which can be represented as, in brief, showing that European publics are cautiously enthusiastic about nanotechnology's potential, though concerned about its regulation. While a number of surveys have given a sense of public awareness and opinion of the technology and some of the factors that dictate this (Bainbridge 2002; Castellini et al 2007; Cobb and Macoubrie 2004; Currall et al 2006; Gaskell et al. 2004; Gaskell et al. 2005; Lee et al 2005; Macoubrie 2005, 2006; Nerlich et al 2007; Peter D Hart Research Associates 2007; 2008; Schutz and Wiedermann 2008; Waldron et al 2006), qualitative studies have shown in more detail the texture of public concern and the directions laypeople are keen for nanotechnology to take.

Such qualitative studies of public perceptions of nanotechnology began with a study commissioned by a Royal Society and Royal Academy of Engineering Working Group (BMRB Social Research 2004). This found considerable ambivalence towards the technology: while enthusiasm and excitement was expressed towards prospective applications, notably in the medical domain, and in its potential to improve quality of life, concerns were also expressed as to its impending transformative impacts in restructuring social and economic life, coupled with unease on possible long-term and unforeseen effects. A report by the Nanotechnology Engagement Group (NEG, see Gavelin, Wilson, and Doubleday 2007) has summarised the findings of UK public engagement on nanotechnology in similar terms[3]. The NEG report discusses each public engagement project's findings in detail, as well as synthesising these in the form of recommendations for science policy and for public engagement. It suggested that there are three key areas consistently raised by lay publics deliberating nanotechnology: the need for research to focus on nanotechnology with clear social benefits, such as medical or energy technologies; concerns about uncertainty and regulation; and the need for openness, transparency, and public engagement.

Public engagement and deliberation with nanotechnologies, then, has produced a consistent set of findings over the last decade. Laypeople, while enthusiastic about some applications, tend to view technology as a double-edged sword. They are concerned about the social context that technologies develop in, and keen to see processes of technological governance opened up. Internationally, there are few divergences from these key findings, with engagement processes in France (Ile-de-France 2007) and Switzerland (Rey 2006) producing similar recommendations to UK processes (Bowman and Hodge 2007). Indeed, a key finding of the *Swiss publifocus* process was simply a marked ambivalence towards nanotechnology (Burri and Belluci 2008). Public engagement activity in the United States has been more limited (though see Bell 2008; Besley et al 2008; Powell and Kleinman 2008; Toumey et al 2006), although the investment of a NSF funded Centre for Nanotechnology in Society has created a context for deliberative research which is rapidly being translated

into initiatives, the most notable of which so far has been an integrated set of consensus conferences on human enhancement set within a National Citizens' Technology Forum (National Citizens' Technology Forum 2008).

DEEPEN project research

More recently, research carried out as part of the DEEPEN project used extensive empirical interventions to try and uncover in more detail the ways in which public responses to nanotechnology develop and are resourced. In responding to the challenges of public engagement on emerging technologies – lack of public awareness, the 'incredible tininess' of nanotechnology, the complexities of developing a 'nano-imagination' (see Nordmann 2005; Macnaghten 2009) – DEEPEN project research drew upon group performance and theatrical techniques based on the work of the Brazilian dramatist Augusto Boal on the 'Theatre of the Oppressed' (see Babbage 2004). Theatrical techniques are able to harness unexamined, affective and intuitive ethical responses, and thus provide insight into the social dynamics and the perceived moral orders driving those responses. Through them it is possible to examine the shaping of ethical narratives and the resources that people bring to bear on this process. The UK-based research involved six groups (of six to eight individuals), covering standard demographic criteria, and selected around commonalities likely to have relevance to negotiations of the ethical issues nanotechnology presents[4]. Each group met twice, for an evening focus group, and then, in conjunction with another group, for a Saturday workshop.

Focus groups lasted approximately three hours and involved an initial discussion of the role technologies played in participants' lives before a fuller discussion around stimulus material introducing nanotechnology and the visions around it. The workshop gave participants the opportunity to further reflect on and act out futures where aspects of nanotechnology had become reality.

This series of engagements therefore provides a large tranche of data which can be used to examine the ways in which laypeople grapple with the meaning of a technology that remains 'in-the-making'. While each group discussion had its own character and

3 These included the 2005 NanoJury UK, a citizen's jury; the 2004-06 Small Talk programme, which sought to coordinate science communication-based dialogue activities; Democs, a conversation game designed to enable small groups of people to engage with complex public policy issues; the Nanodialogues project (2005-6), a series of practical experiments to explore whether the public can meaningfully inform decision-making processes related to emerging technologies in four different institutional contexts; and the ESRC funded 'Moving Public Engagement Upstream' project (2004-06), set up to examine the contribution of nanotechnology to sustainable development by developing socially and environmentally-sensitive governance processes which move the site of public engagement upstream.

4 The groups were: a church group; a student environmental and social justice group; a group of (female) users of organic products and alternative therapies; a group of (male) 'confident supporters' of technology; a group with interests in local community involvement; and a group who saw themselves as having authority in their workplaces.

emphasised certain issues – one group, for example, focussed on questions with a global scope, while the discussions of another were particularly tinged with a sense of inevitability and personal powerlessness – key themes were also repeated across all groups. The data can be read as providing an account of the content and context of lay hopes and concerns around nanotechnology, to an extent that has not been possible with previous research. Below we detail some key thematic areas.

A significant part of the discussions were concerned with far-reaching questions surrounding what it means to be 'human', and the ways that nanotechnology threatens this. Being human was seen as something that had an almost sacred quality, and as something that should not be tampered with unless for good and well considered reasons. Key threats to this notion of the human posed by nanotechnology included the potentials for loss of individuality, for the disruption of a natural life course (in terms of conventional understandings of birth and death), and for the blurring of human life with machines. For example, the concept of a particular and settled life course was frequently drawn upon. While people agreed that conventional understandings of the life span were changing, not least due to technological advances, the core concepts of life and death were nevertheless seen as constants. As this extract from one group's discussion indicates, "we're born we die" was seen as fundamental to being human:

> **Sam:** The one issue I have is this issue about death. Which is a obviously a um goes against the grain of the human race. We're born we die. Without the two endproducts the human race will not exist.[5]

This thematic position converged with discourses of the 'natural' and of the dangers of messing with natural orders. These categories were at times self-consciously reflected upon and critiqued, but remained key in many people's arguments. The extract below shows a participant summing up his views at the end of a set of exchanges about human/machine differences and parallels, following a more specific discussion as to whether the 'unnatural' is necessarily bad:

> **Liam:** My thing was the sort of the- a lot of the things that were said seem wonderful and we should be working on them as fast as possible, but a few of the things were a bit- messing with natural things, pushing- too much human interference in natural things is a very scary prospect, and you need to be very careful whenever you do anything like that, like designing babies or putting stuff in ecosystems or anything like that. So, messing with the natural order of things, I guess.

Individual choice and autonomy were also seen as key categories in negotiating the rights and wrongs of using nanotechnology. Sometimes this was framed as being an issue of consumer choice; most often, however, it was expressed in the view that it would be wrong to dictate particular ways of behaving to others, as in the comment below:

Mod: Are these like things that we all should abide by? Or does it depend on some person or company?

Pat: On the person. I would not let you decide something I wanted to do. It would be up to me. I would not decide something you wanted to do. It's up to the individual.

The power of money was frequently mentioned in the discussions. This was expressed in several ways: consumption practices were seen as important drivers of the technology and as generating potentially unsustainable and socially disruptive pathways. The groups were frequently critical of this, but at the same time acknowledged its power and its lure (leading to the sense that they, as consumers, were at least partly responsible for the way in which the technology was driving forward through their purchase of new products and services). But financial drivers were also referred to more generally. Money – from big business or government – was seen as the key force shaping new technologies. These, then, were ultimately viewed as driven by self-interest and as likely to develop in ways divorced from a wider sense of the public good.

Discussions of financial drivers often linked to broader questions about control, distrust of those seen as being behind nanotechnology, and feelings of powerlessness. The exchange shown below is typical, indicating a shared sense of lack of choice, lack of knowledge, and lack of control:

Mod: That's interesting. Is there a sense of inevitability by the way?
Tess: Yes.
Mary: Frighteningly so.
Evan: I think so.
Della: Yes.
Cath: Yes, terrifyingly so.
Evan: You're getting it whether you want it or not.
Mary: Well we are in those products there that are presumably all available in [town name]. We didn't know even.
Tess: Exactly.
Mary: It's happening. It's coming to us.
Evan: Too much is like a massive financial railroad that's behind it that's just driving it on.

These themes overlap and interconnect: the seductiveness of nanotechnology's promises co-existed with participant's expressed ambivalence towards the technology, while the way in which nanotechnology intensified existing anxieties was linked to concerns of a consumerist society. In addition, as previous research has suggested, many of these concerns were connected to participants' experience of those driving and funding the technology,

5 All names have been changed to ensure anonymity, although the gender of the speaker is indicated by the name given. 'Mod' represents the researcher charged with moderating the discussion.

such as national governments, big business and the military. What are their motivations? How will they affect how the technology will be used? And can they be trusted? Ultimately, many people thought that the accumulation of these factors would inevitably generate a disaster of some kind – whether environmental, social, or moral.

Understanding public talk: Cultural narrative as resource

Data from the DEEPEN project and other qualitative interventions can, then, be understood as providing a sense of how public groups are likely to respond to nanotechnology as it develops and impinges more and more on everyday life. But it can also be analysed to explore in more detail how such concerns are created and structured within talk. What underpinning dynamics drive anxiety about, say, the big business drivers of technology? How do such concerns fit into broader society and European cultures?

Our analysis suggests that the concerns and excitements that appear within focus group talk can be understood as being structured by a number of archetypal and deep-rooted cultural narratives – familiar and enduring stories which act as a resource for responding to new developments. These are 'master-narratives' in Agnes Heller's sense: "guides of imagination" and "references to a shared tradition" which are "not just cognitively understood but also emotionally felt, without footnotes, without explanation or interpretation" (2006: 257). The narratives we identify as important in the focus group context are familiar stories that are deeply embedded in European culture, and which provide foundation and strength to a more broadly applicable type of imagination. Concerns about nanotechnology, in other words, form part of a larger context of concerns about technological society in general, and general cultural storylines can be applied to them. We have identified five such narratives underpinning responses to the issues posed by nanotechnology:

1. 'Be careful what you wish for';
2. 'Opening Pandora's box';
3. 'Messing with nature';
4. 'Kept in the dark';
5. 'The rich get richer and the poor get poorer'.

The names of the five narratives indicate, in shorthand, their storylines. Indeed, their very familiarity is a sign that they are deeply rooted within contemporary culture, and can be understood as mythic cultural tropes. We briefly characterise each of these narratives below, adding some illustrative quotes to give a sense of the ways in which aspects of each narrative shapes public response and talk.

'*The rich get richer and the poor get poorer*'. This narrative derives from considerations of political economy and the way in which commercial and consumption-oriented drivers are likely to engender further injustice and inequality, both globally and locally. Ultimately, the story goes, promises of green or socially relevant technology will result only in the

rich – big business and the already-powerful – benefiting, while the poor or excluded will remain so. At a global level, this draws together concerns about a wealthy, consumer product-focused West enjoying both the technologies and their profits, while the global South is left behind; on a more local level, it is linked to concerns about the practicalities of ordinary people securing access to medical advances or consumer goods enabled by nanotechnology – as in the extract below, in which the question of cost is addressed:

> **Oscar**: I would like to hear- to reflect if there are any negatives certainly about how- we've already mentioned the question of cost. Who can afford it?

This narrative, with its normative emphasis on equal access to the benefits of nanotechnology, encodes powerful notions of morality. Ideals of justice, fairness, and equality are thus used to critique nanotechnology's potential development.

'*Kept in the dark*'. The 'kept in the dark' story expresses a deep-seated sense of powerlessness shared by participants in the face of nanotechnology's troubling but inevitable development. Not only were participants generally unaware of the technology's existence and potential, but they had – they argue – little way of having any meaningful impact on it. Thus, as Tessa says:

> **Tess**: I think, for me, it's that powerlessness really. People, me, we, probably feel quite powerless to actually make any difference to what's going to happen. Because a lot of it has already been happening...

The narrative thus weaves together a range of ideas around control and power as well as the sense of modern alienation in the face of secret and unreachable institutions. Such institutions included government, corporations and the military, all of which were viewed as driven by dubious motivations (power, self-interest, money) and as likely to drive the technology in problematic directions.

'*Opening Pandora's box*'. The story of Pandora's box is a familiar one: a temptingly closed box, when opened, releases the gamut of human evils. It incorporates ideas of potentiality and uncertainty, of hubris and meddling with things that should be left alone, and of danger and, ultimately, disaster. Such notions are important in structuring lay responses and negotiations of nanotechnology. Indeed, the Pandora's box story is at times explicitly mentioned as symbolising participants' concerns:

> **Mary**: This is all then the equivalent of opening Pandora's Box isn't it? It looks great but you take the lid off and then out it comes, there's no getting it back in again.

Such a narrative brings together concerns about the technology's unforeseen risks, uncertainty, and danger – all of which are viewed as key realities arising from a science that is hubristic and arrogant in meddling with what it doesn't fully understand. Linking in to the

'kept in the dark' narrative, misuse and disaster are seen as almost inevitable: those driving the technology, its effects once 'out of the box', and the inevitability of it 'falling into the wrong hands' make this a near certainty.

'*Messing with nature*'. This narrative summarises concerns around the disruption of nature, the natural, and the human. It implies that orders and boundaries which should – generally – remain left alone are being dangerously messed with, blurred and transformed, and it therefore encodes an ethical judgement: nature should not be 'messed' with. (Note that this leaves open the possibility of other, permissible ways of interacting with and transforming nature. It is the notion of 'messing' – or tampering, or fiddling, or tinkering – that is morally dubious.) Boundaries around the human are not the only ones seen as being potentially transgressed. Natural orders more generally were viewed as threatened by nanotechnology in narratives around the destruction of (right) limits and boundaries. For Deb, for example, disruption of the human life course links in to a broader re-negotiation of evolution as a general principle:

> **Deb**: It's kind of the fact like there's no reason to die at all, it kind of makes you think where's the world going to, it's kind of going against the whole evolution survival of the fittest if you start eradicating all the diseases, and helping people live forever. You have to re-question what life is.

Particular flashpoints for these concerns were troubling notions of nanotechnology as enabling actors to 'be God' or to 'create': this talk seemed to summarise many of the threats the technology presented.

'*Be careful what you wish for*'. This final narrative draws together ideas about perfectibility, desirability and the ethically troubling character of the seductive promises nanotechnology holds out, expressed in the age-old notion that getting exactly what you want may not ultimately be good for you. Given that nanotechnology is seen as fundamentally driven by commercial considerations, it is inextricably linked to a framework of consumption and consumer products, often seen as desirable. These desires are, however, interwoven with moral stories about whether it is right to indulge them. Nanotechnologies are presented as temptations into which people are seduced but which may have harmful consequences – such as social inequality and breakdown, as in the extract below:

> **Theresa**: Um, and I just think we, if we all... if the way life is now, it's all materialistic, it's all shallow and we think everybody should look perfect and that's the priority in life, if this heads the way it looks like it could possibly be heading, what about these poor people who are going to be caught right in the middle of it where some people are going to look perfect and some people aren't going to have the money or the ability to access whatever is going to matter. So we may be perfect, but what about these other people who can't look perfect and the emotional, the breakdown that's going to happen is going to be so unnatural.

In particular, nanotechnology's promise of perfectibility is seen as double-edged: participants are 'careful of what they wish for' in that perfection is itself seen as a dangerous path. This narrative is perhaps the most clearly moral of all that we have identified. It encodes the ethically loaded concepts of seduction and temptation, and also links to stories about 'being human' through celebrating the fragility and imperfection of human life.

Discussion

Processes of public engagement with nanotechnology have, then, started to point us to the ways in which laypeople consider and take positions on nanotechnology. Research and deliberation have amassed a set of concerns and enthusiasms that laypeople have with regard to the technology's applications and development, and have suggested directions that nanotechnology should be driven in (towards publicly accountable research, for example, and applications that will be beneficial to those with the greatest need). More recent research has suggested that these public views can be understood as being shaped by underlying narratives – discursive structures that run through European culture and which are drawn upon in order to formulate positions to new technological developments. The lay narratives we have identified express dilemmas and dynamics which run as patterns through European society, but which will wax and wane as contemporary circumstances change. These narratives thus act as an expression of important currents within lay culture which resist the trends nanotechnology is seen as imposing; it is important, then, to understand public responses to nanotechnology as part of a much wider sense of anxiety around technology's effects on our lives and, ultimately, what it means to live within contemporary technological society.

The broader context to current interest in public responses to nanotechnology and to public deliberation is, of course, policy interest in new forms of technological governance. What are the implications of this DEEPEN project analysis for the move towards 'responsible development' and publicly accountable anticipatory governance?

First, we want to suggest that a key finding from our analysis is – very simply – that lay reactions to nanotechnology are complex. Public responses to the technology, or even to particular applications, are not simply either positive or negative; rather, pros and cons are seen as intermingled and often inseparable. Laypeople are also not content with weighing up risks and benefits: the deeply rooted cultural narratives drawn upon represent contemporary dilemmas and questions, acknowledging that these have no easy answers. They suggest contradictory and powerful pulls on our hopes and desires: yes, of course we long for better medical technologies, but at the same time are anxious about the implications they will have for what it means to be human. We want more equitable access to technology, but at the same time know that, often, we are the 'rich' for whom consumer technologies are designed.

A key implication of such findings is that both social scientists and policymakers need similar sophistication in understanding and acting upon them. Our methodologies should not box in and over-simplify laypeople's thinking on nanotechnology's implications. We must move beyond the language of 'pro or anti', and 'risks versus benefits', and acknowledge that the judgements about nanotechnology that all of us make – whether layperson, scientist, or policymaker – are not easily encapsulated in tick box surveys. We recommend, then, that more thought is given both to the way in which public opinions are measured and to the ways in which publics are understood and involved in engagement activities. Both of these processes, we suggest, need to grapple further with how complex public concerns can be represented to and incorporated into policy.

A second point follows on from this. Once we take the complex nature of public opinion seriously, we need to start to deal with the content of lay concerns in policy on nanotechnology. Policymakers need to acknowledge the strength of feeling around these issues and to seek to integrate more thoroughly the values they convey into nanotechnology research programmes. The narratives that structure public responses to nanotechnology express some of the most troubling and profound questions of our society – a widely felt sense of disempowerment in everyday life, entrenched local and global inequalities, the tension between our desires and moral, relational or social health. At the very least they point to an enduring sense that the essential reasoning of technoscience – the twinning of science and social progress – is one that is flawed. Their use in response to nanotechnology indicates that there is much at stake in the technology's development: it is not simply a question of whether risks outweigh benefits or not, but that nanotechnology will re-shape our entire experience of life in late modernity. The challenge for those involved in shaping nanotechnology's (responsible) development is both to acknowledge this, and thus to resist the 'false humility' that suggests that nothing new is being undertaken, and to find ways of incorporating these questions, concerns and excitements into emerging research programmes (Dupuy 2009).

The question this begs – of exactly how to go about doing this – is a significant one, not least because letting lay narratives intervene in science and innovation policy will involve grafting together two very different philosophies. Current regulation and innovation policy on nanotechnology – such as voluntary reporting mechanisms, debates about toxicology, or even the incorporation of 'Ethical, Legal, and Social Aspects' (ELSA) research – can be understood as speaking to the challenges of technological governance in being fundamentally designed to be 'enabling': they are fundamentally structured to drive forward innovation, albeit in ways that are societally robust. Similarly, the rationale of policymaking is calculative and predicated on being able to weigh up pros and cons, risks and benefits. How can this be married with lay perspectives that emphasise unanswerable dilemmas and which view technology as a double-edged sword for which positives and negatives are inextricably intertwined?

There are no easy prescriptives for this challenge – and we feel it is important to emphasise that it is, indeed, a challenge. But there are some obvious ways forward which at least seek to make participatory governance more receptive to lay perspectives. We are, for example, in the

midst of witnessing the emergence of a set of governmental technologies in the governance and regulation of nanotechnology – such as public deliberation, ethics and foresight – which are built into technological development at upstream stages. This is laudable, but within this move public engagement often remains represented as a mechanism through which to restore public trust by increasing the transparency and accountability of scientific governance and policy development. Though policy increasingly speaks of a commitment to forms of upstream public engagement, the clear rationale of this policy development is often to ensure that technologies are not 'held back' by public scepticism. In addition, within the practice of these processes it remains all too common to recreate the kind of hierarchical relationship between 'experts' and 'laypeople' which deliberative fora were supposed to overcome.

Public engagement activities, then, are too often marked by mixed motives and confused practices. Though viewed as a key element of 'responsible development', it is often not clear what their purposes are and how they will be used within nanotechnology policy and research and development. If policy is to engage with the perspectives of the lay public, a clear first step is to reconsider – and innovate in – the practice of these processes.

In sum, our discussion and its implications can be summed up in four key recommendations for the understanding of public responses to nanotechnology and the practice of public engagement:

1. Understand the complexity of public 'attitudes';
2. Engage with enduring public narratives;
3. Acknowledge that public engagement is difficult;
4. Be innovative in engagement practices.

These are, of course, only a starting point for policy and research. But our aim is that these points provide scope for a conversation that helps develop public engagement on nanotechnology to better take into account lay narratives of technological development.

A final point. Discussion of responsible development of nanotechnology, we would suggest, represents a moment of opportunity. On the one hand 'responsible development', and its embodiment in a range of contemporary governance initiatives, might be taken up in a way that opens up the development of nanotechnology to public and democratic debate and deliberation. On the other hand, notions of responsible development could be used strategically to close down debate and to ensure the perpetuation of technocratic modes of decision making. If the debate is to go in the former direction, it must be ensured that the current effort to embed the values of responsibility in contemporary research practice operates as a site for asking important questions. Who is this technology for? Who will it benefit? Who is looking after the long term? Who will be responsible if things go wrong? If such questions are at the forefront of public examination of nanotechnology, we may have found a way to start to embed the concerns of laypeople into the practice of policy.

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3. Positions and responsibilities in the 'real' world of nanotechnology

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Introduction

The eventual performance and application of emerging technologies such as nanotechnology is uncertain, and their further effects on society are even more uncertain. Still, visions are put forward and debated and actions are taken. The German sociologist Ulrich Beck has diagnosed contemporary society as showing 'organised irresponsibility': modern technological society allows scientists, engineers and industry to develop and introduce all sorts of new technologies (chemical, nuclear, genetic modification) while it structurally lacks means to hold anyone accountable (Beck 1988; 1995). As Merkx (2008) has argued, it would be better to think in terms of an ongoing organisation of responsibilities, which cannot always keep up with advances in science, technology and industry. For nanotechnology, there is recognition of this problem and there are attempts to articulate what responsible development might be (there is, in other words, reflexivity). However, it is not always clear what this implies for organising responsibilities.

Accordingly, we have studied what present visions and attempts at articulating responsibilities are by looking at ethics in, as it were, the 'real' world. A striking fact is that nanoscience and nanotechnology are still so open and uncertain that there are almost no specific ethical issues and challenges. The various actors involved fall back on their own positions and what they see as their 'mandate' to justify their visions and actions. This is understandable as a way to reduce complexity.

Briefly, in our interviews we saw how scientists drew on a standard repertoire in which science and ethics are separate: they had 'recourse to the technical' and alluded to their (partly self-defined) mandate to work towards progress in science. Industrial actors, and chemical companies in particular, were concerned about lack of trust in industry and showed enlightened self-interest in their involvement in initiatives around the responsible development of nanotechnology. For NGOs, there may be a standard repertoire as well, about the need for concern and to be precautionary. (We note in passing that publics as such have no positions/mandates, so fall back on general cultural repertoires when asked to say something. See Davies, Macnaghten and Kearnes 2009; Ferrari and Nordmann 2009.)

These standard repertoires build on what we call (present) divisions of moral labour and allow the actors to continue to play their roles. For example, the repertoires of scientists and industrialists reflect an 'enactor' perspective: the promise of nanotechnology must be pushed and ethics is seen as a brake on progress. While some division of moral labour is necessary, one should not assume that the present division, with its roots in the past, is still adequate. To enable critical reflection, by the enactors themselves as well as by other commentators, it is important that standard repertoires are opened up.

In this chapter we will develop this diagnosis on the basis of the presentation and analysis of interview and other data.

Positions and visions

The 'real' world is full of references to accepted and/or desired roles and responsibilities of various actors. This in and of itself includes ethical stances. The reference to 'responsible development' induces further positioning. An indicative (and strongly formulated) example is offered by US Under-Secretary of Commerce Philip Bond:

> Given nanotechnology's extraordinary economic and societal potential, it would be unethical, in my view, to attempt to halt scientific and technological progress in nanotechnology. (...) Given this fantastic potential, how can our attempt to harness nanotechnology's power at the earliest opportunity – to alleviate so many earthly ills – be anything other than ethical? Conversely, how can a choice to halt be anything other than unethical? (Bond 2004)

While scientists and industrialists might subscribe to such a vision in general, their immediate concerns are more mundane.

In a small focus group, a scientist said:

> ...well, basically with my work, I would say my duty includes having a prosperous group... which is good for the university, so the university wants me to do this, then yeah, this duty requires me to ... look at what funding agencies are asking for...

The issue of responsibility was not always reduced in such a clear-cut way. The tension between developing a technology and the use to which the technology is put was seen by the participants as a grey area in the responsibility of scientists:

> ... if you invent something, you are responsible for the invention and it has certain consequences – there are various applications and you cannot predict all these applications. It can be misused in the future and then the question is – are you still responsible for that as a researcher?

A scientist we interviewed on the same topic was very clear about who should be responsible for applications:

> I think it's mainly industry and people who are selling products and putting them onto the market who should be asked OK, is this safe or not, and they can ask us to help them to answer this question.

Clearly, these are attempts to invoke a division of moral labour where it is clear who should do what and who should be held responsible. In their study of a year long interaction between bioscientists and citizens in Vienna, Felt and Fochler noted how:

> (...) scientists (...) more or less explicitly rejected taking responsibility for any consequences of the knowledge they produced beyond quite narrowly defined imminent risks arising from their work (such as transgenic mice escaping from their lab). Taking any role in the governance of these consequences was not part of how they envisaged their professional role. Their argument for not doing so was to be only doing basic research, without any concrete focus on application. Any applications would need to be developed by other actors at a later stage, andsuch implications would then have to be decided 'by society'. (Felt and Fochler 2008: 495).

In the exercise Felt and Fochler reported on, the citizens did not accept this division of moral labour:

> ...while this issue was not that disturbing for the scientists, because they only felt marginally concerned by this question, many citizens were quite upset by the scientists' refusal to consider their responsibility as an issue to reflect on... (Felt and Fochler 2008: 495).

Our point is not to criticise this stance of scientists – there might be good reasons for such a division of labour. We want to ask, though, whether this vision is sufficiently thought through and whether it goes beyond referencing a standard repertoire. This question is pertinent because there is also a tendency of scientists to cash in on the good things, but refuse responsibility for the bad things. As Jerry Ravetz once formulated this dynamic: "Scientists take credit for penicillin, but Society takes the blame for the Bomb" (Ravetz 1975: 46).

Industrialists can play a similar game of praise and blame when they put all responsibility on consumers who buy (or do not buy) products, or, more abstractly, refer to market forces which are outside of their control. The industrialists in our interviews were more focused, however. When asked about responsible innovation, interviewees said (with reference to corporate social responsibility):

> That's part of our DNA.

> It's part of the total philosophy... it's a total attitude – you can't just split parts of it... it's part of the total way we do business.

In particular, chemical companies, with their experience of the so-called Responsible Care Program (which commits to working in an environmentally friendly way), were willing to take up notions of responsible development. In practice, this means attention to safety and health issues of employees and transparency to the outside world.

In general, it can be an asset for a firm to be seen as a 'good firm'. A respondent from a chemical company said:

> Our approach to transparency is as a result of our experiences in other technology and safety debates... it's a kind of lesson learned and what we now want to do is to go another way, to go into the public debate of nanotech. And we hope it will end more successfully than other debates. So, we do this very early, this is sometimes also difficult but for the moment we see no alternative to go another way.

This kind of early engagement with nanotechnology is double-edged, however:

> It is a risk and sometimes ends in reputational damage [of your company]. Those companies that are transparent are also the focus of NGO debates because nothing is known [of what other companies are doing].

There is an explicit ethics of enlightened self-interest here.

For broader issues, such as the debate on precaution and a possible (partial) moratorium – for example on nano-particles, as called for by NGOs like ETC group and Friends of the Earth – broader views were offered. There was a unified negative response to the call for a moratorium. Respondents felt that a moratorium would stop progress, and referred to the benefits which nanotechnology can bring to mankind and the environment. Their earlier reference to gradual evolution ("we're continuing what we were doing already") shifted and they now positioned nanotechnology as 'revolutionary', referring to its role in the effort towards climate protection or in the fight against cancer.

Interestingly, the industrialists' view of the role of NGOs referred to a division of moral labour, starting with a practical observation. One respondent saw the call for a moratorium as "a bit of a knee-jerk reaction" but conceded that "they're right in one sense, I guess, there's always a chance that we don't understand [the risks]."

This can be elaborated, as when another respondent said he thought the concern of NGOs about nanotechnology is:

> ...a very good thing, in the sense that there are groups of people who watch the developments and look critically at it, ask questions to make sure that everybody is keen on, let's say, the balance between opportunities and the potential risks. Well, that's the impression I have. Also, I believe that even the groups that are sort of aware and ask critical questions, my personal impression is that they are also looking for the balance and about what is really the issue; and only the ones who are very political will make a firm statement like there should be a ban before we know enough.

Here, the respondent introduces a distinction between 'good' and 'bad' NGOs. The latter category appears to be upfront in the mind of industrialists. In meetings and interviews, one can actually hear industrialists (and other enactors) qualifying such bad NGOs as agitators, failing to act in good faith, using misleading information to further their cause and painting different nanotechnologies with the same brush.

Divisions of moral labour

Division of moral labour is a general phenomenon in our society. It refers to a division of obligations and commitments, as well as to notions regarding who is eligible to be praised or blamed. The division of moral labour can be approached normatively by inquiring into whether the present division of moral labour in science is a 'good' one. This is also an ethical (and political) question, but of a second-order. It makes visible ethical, and more broadly normative, aspects by inquiring into the justification of present arrangements, rather than taking them for granted. One example is the justification of the common division of moral labour for science: that scientists have a moral obligation to work towards progress and that that is how they discharge their duty to society. This mandate is legitimate as long as scientists deliver on what they promised, while maintaining the integrity of science.

While aspects of the division of moral labour in the nanotechnology world can be criticised, the solution is not to dispense with the division of moral labour. The challenge of organising responsibilities remains.

At the moment, one sees recourse to traditional roles (by critical actors, such as some NGOs, as well as by scientists) and the use of standard repertoires. Moreover, there is a focus on concrete issues of transparency and risk, while the repertoires and divisions of labour that shape the debate on such issues are backgrounded. This may well create limitations in working towards productive solutions. Thus there is a need to critically reflect on standard repertoires and on the value of implied and *de facto* divisions of moral labour.

There is an important ethico-political point involved here. A division of moral labour is effective when it is accepted and implemented, as if it were solid – or, better, solidified. In changing circumstances (which might include changing values, for example on precaution or about participation), where responsibilities may have to be redefined, the solidity of the division of labour will become a hindrance rather than a help. It has to be opened up, 'melted' as it were, so that there is space for new configurations. (In this respect, the conceptual distinction introduced by Swierstra and Rip (2007) is useful: while morality is characterised by unproblematic acceptance, ethics is characterised by explicit discussion and controversy. Thus, ethics is carried out when moral routines and standard repertoires of moral argumentation are put up for discussion. Swierstra and Rip then refer to ethics as 'hot' morality and to morality as 'cold' ethics – highlighting the notions of melting and solidifying.)

Actually, one sees the opening up of existing divisions of moral labour in a number of ways.

First, recent initiatives for codes of conduct for nanotechnology and receptivity to these initiatives, in terms of willingness to discuss such codes seriously, provide an opportunity for the opening up of standard repertoires. A code of conduct is a self-binding action. A key feature of such codes is that they assume, and thus create, a public space where a subscriber to the code can be called to account by other actors referring to the code. This is

reflected in the (justified) reluctance of industry and other actors to subscribe to broad circumscriptions in codes, as they open up to too many (unexpected, risky) critical calls for being held to account. On the other hand, such public spaces allow for deliberation and 'probing each other's worlds' and can be used for learning by all parties.

Second, there are 'third parties' who do not develop nanotechnology themselves but who exert leverage on developments through their actions. For our question of opening up, the entrance point is that third parties such as funding agencies (for science) and venture capitalists and insurance companies (for industry) may require anticipation on adequate societal embedding. There are already examples of such third parties becoming proactive. Nano-enactors must then develop relevant competencies and act upon them.

Codes of Conduct and proactive third parties can be seen as soft governance structures, offering direction but without authoritative sanctions. What is important here is not whether they are effective or not (because the goals they pursue may not be appropriate), but whether they stimulate critical reflection on background issues, and thus provide openings for longer-term changes.

Ethical reflexivity rather than consensus

It is clear that there are differences in the visions and ethical stances of actors, and these can be a challenge for communication and further interaction. This does not imply, however, that one should strive for consensus; definitely not at this stage of development, in which opening up earlier repertoires and roles is important. In addition, difference also provides opportunities. This implies that there is a need for 'design for difference' methodologies which can be implemented in order to handle difference and a variety of perspectives in interactions.

In such interactions and attempts to solidify elements of a new and better division of moral labour, much more is at stake than ethical reflexivity at the individual level.

In the real world, ethical reflexivity of actors is caught between individual agency and institutional role. Individual ethical reflection runs up against institutional and moral divisions of labour, both in the nature of the reflection and in the boundaries set on action based on such reflection. In other words, for change to occur, there have to be openings at the institutional level.

This is where Beck's (1994) diagnosis of 'reflexive modernisation' comes in. Institutions of modernity, including science, are confronted with the effects of what they do (how they function) and start to change, somewhat reluctantly. This introduces a reflexive component into their functioning. Broadening the notion of the ethical, one can speak of ethical reflexivity at the institutional level.

Actually, a further broadening is possible, by considering the politics of responsible innovation. There are of course immediate politics in the sense of struggles and negotiations about directions to go and arrangements to make. However, there are also 'deep' politics, in the sense that divisions of moral labour and, in the end, the constitution of late industrial society, may shift. And this may happen reflexively.

Nanotechnology may not be as revolutionary in its impacts as some of its proponents present it. However, it may well be revolutionary in that it is the occasion to explicitly, and at an early stage, combine immediate and 'deep' politics. While the outcomes are unclear at this stage, the process is important and should be nurtured. Our analysis offers building blocks.

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4. A governance platform to secure the responsible development of nanotechnologies: the FramingNano Project

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Introduction [2]

New technologies are usually associated with both advantages and hazards, and nanotechnologies do not depart from this rule. Attention to and interest in these emerging technologies has been widespread. They are poised to initiate a radical discontinuity in science and technology: they are capable of enabling revolutionary new ways of manufacturing and the production of materials and devices with unprecedented characteristics and functionalities. Expectations are high, but it is nevertheless a widely shared opinion that the benefits promised by nanotechnologies will be fully realised only if their development leads to sustainable applications. A governance system which addresses, in a timely manner, the potential risks and concerns associated with them is therefore of fundamental importance.

Various studies have underlined that these risks and concerns are not simple to identify or to determine. Even if there were clear-cut cause and effect connections, and if our understanding of these were to develop rapidly, knowledge about the effects of nano-related products on humans and on the environment and of their ethical and social implications will inevitably remain dominated by a high degree of uncertainty and ambiguity. [3]

It is necessary both to develop a clear framing of the risks and concerns associated with this technology and to build a proper level of trust and confidence amongst stakeholders and the broader public. This will help to distinguish between real and perceived risks, and to define acceptable trade-offs between the risks and benefits of using of nanotechnologies. Information and communication are crucial to this end.

The lesson from previous emerging technologies (such as, for instance, the debate on Genetically Modified Organisms, or GMOs) has been that information which is disseminated by industry alone is often seen as biased, and, as a consequence, is perceived as deceptive. Interactive, bidirectional communication, rather than one-sided information, is considered fundamental in gaining public confidence.

An effective governance approach for managing the effects of nanotechnologies – both risks and societal concerns – will therefore have to increase the level of interaction between those developing, producing, selling and regulating nanotechnology, as well as with civil society generally. It will also need to establish open, neutral and trustworthy communication pathways. [4], [5] The FramingNano project, developed in response to a call under the Science and Capacities Area in FP7, started in May 2008 and aims to translate these interfaces into practice.

The general objective of the project is the establishment of an open, international multi-stakeholder dialogue involving scientific, institutional, and industrial communities and the general public, in order to foster the development of a shared frame of knowledge and of objectives and actions which define constructive and practical regulatory solutions for Nanosciences and Nanotechnologies (N&N). [6]

The process is geared around four key activities:

- *Analysis* of existing and on-going regulatory processes, science-policy interfaces, and research on risk assessment;
- *Consultation* with stakeholders to assess attitudes, expectations and needs and to provide a list of issues for discussion in the deliberative process;
- *Framing* of these issues, leading to a governance platform for the responsible development of N&N;
- *Dissemination* of information about nanotechnologies governance developed within the project.

Consultation is a fundamental element in this process. It is supported by various instruments which aim to gather opinion from expert panels and from stakeholder communities (which are understood in the widest possible sense).

Equally important for the project is the presence of the FramingNano Advisory Board (FAB) [7]. This is made up of six experts on N&N regulation and governance, and was established at the beginning of the project so as to complement the competences of the consortium. The FAB will comment on the progress and results of the deliberative process.

As a consequence, the deliberative process will have two distinctive features:

- *Inclusiveness*: It will raise the awareness of all stakeholders of the complex and multi-faceted issues surrounding the governance of N&N; gather stakeholder inputs into the dialogue so as to facilitate mutual understanding; and foster the definition of new models of action and interaction.

2 Some of the information reported in this article refers to unpublished, on-going work of the FramingNano project Consortium. This information will be further discussed in the final documents of the project.

3 See the final report of the FP6 CA Risk Bridge (Building Robust, Integrative Inter-Disciplinary Governance models for Emerging and Existing Risks), April 2009 - www.riskbridge.eu

4 The importance of open governance of scientific research is underlined in the 2009 work programme for Capacities, Science in Society area, European Commission C(2008) 4566, 26 Aug 2008.

5 A broad definition of principles of 'good governance' is provided in the *White Paper on Nanotechnology Risk Governance*, IRGC, June 2006 (pg 35): "principles of good governance, including participation, transparency, effectiveness and efficiency, accountability, strategic focus, sustainability, equity and fairness, respect for the rule of law and the need for the chosen solution to be politically and legally realisable as well as ethically and publicly acceptable".

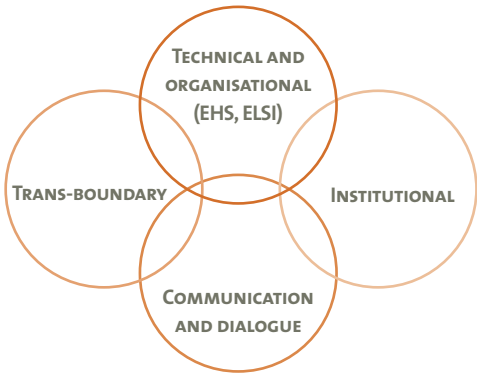
6 Hereafter 'N&N' refers to nanosciences and nanotechnologies in the broadest sense (in a regulation context, the term is mainly used to refer to engineered nanomaterials and nano-related products).

7 http://www.framingnano.eu/index.php?option=com_content&task=category&sectionid=11&id=48&Itemid=85 for the list of FAB members

- *Integration*: It will put into a single context the numerous sets of information, initiatives and opinions associated with regulation and governance of N&N and combine this information, giving a structured overview which indicates the interdependencies of different topics and players and of the different levels of the debate (international, national, regional, local).

The attempt to incorporate all of these aspects into a single framework raises the possibility of having too broad a scope, resulting in an over general and simplified view of the situation. It is likely that more detailed analysis (of specific topics, applications, or levels) will be needed to complement the framework. Nevertheless, in the meantime, putting together different categories of stakeholders allows different positions to be understood in relation to one another and the development of a balanced approach.

The final outcome of the FramingNano project will be a proposal for a Governance Platform which highlights needs, actions and recommendations necessary to pursue the safe and responsible development of nanotechnologies within the EU and beyond. This will provide guidance and inputs at four distinct levels:



- TECHNICAL AND ORGANISATIONAL: prioritising actions and research needs with respect to EHS issues and ELSI, [8] and indicating the roles and responsibilities of the stakeholders involved;
- INSTITUTIONAL: suggesting how to manage and sustain European policy for the responsible development of N&N, and pointing out roles and responsibilities at the level of institutions;
- TRANS-BOUNDARY: identifying trans-boundary issues to be faced at an international, rather than just EU, level;
- COMMUNICATION AND DIALOGUE: proposing how to disseminate trustworthy information and channel stakeholder opinions and proposals into European policy actions for nano-regulation.

Setting the scene

The starting point for project activity has been the identification of relevant groups of stakeholders for involvement in the dialogue process, coupled with in-depth analysis of existing and proposed models and initiatives for nanotechnology governance. Both activities are very important for the economy of the FramingNano project.

Due to their enabling character, nanotechnologies have applications in a large number of sectors and therefore there are a wide variety of stakeholders in them. In order to properly focus the deliberative process, it is crucial to evaluate the different roles and contributions of all of these stakeholders and to pinpoint appropriate instruments for involving them. In the first place attention is focused on 'active' stakeholders – actors who are well aware of the issues related to the development of nanotechnologies and who are able to give informed contributions to the debate. They can be understood with reference to the four categories listed in Table 1, and, through their opinions and activities, are principally responsible for how nanotechnologies develop and are perceived by the public. They are engaged within different phases of the project and contribute to the definition of the Governance Platform.

Table 1- Stakeholders participating in the deliberative process

Social group	Knowledge/inputs
Researchers	Research organisations and institutions; industrial research; foundations (dealing with nanotechnology research and development (R&D), sustainable development, law and social sciences, etc) who have the scientific and technical expertise necessary for defining EHS and ELSI issues.
Business People	Representatives of industries involved in the development, production, processing, and use of nanomaterials and nano-related devices; retail organisations; insurance and financial institutions; professional organisations. Product and occupational health and safety are key factors in their activity.
Policy makers	Policy makers (governments, national and international authorities, regulatory agencies, standards organisations, lawyers). Responsible for supporting (R&D) in nanotechnologies. Their decisions and actions on to how to cope with EHS and ELSI can shape the direction of developments in the field. In some cases, awareness about N&N issues is low and must be raised.
Citizens (CSOs)	Non-governmental, consumer, public health, environmental, and labour associations and organisations. Civil Society Organisations (CSOs) in principle reflect the positions of citizens with reference to transparency and openness about activity in the field of nanotechnology; regulation; and information about potential benefits and risks. Their point of view can be relevant in shaping debate on the responsible development of nanotechnologies.

8 'EHS' refers to Environment, Health and Safety issues related to N&N. 'ELSI' refers to Ethical, Legal and Social Implications.

Besides the 'active' stakeholders, 'non active' stakeholders (those people who are not directly involved in the development of nanotechnologies, but who are likely at some point to be confronted by them) will also be involved in the discussion. In the first stages of the project these actors' voices will primarily be heard through the CSOs, but in the last phases they will be directly involved in discussion and commentary or in presenting the outcomes of the project.

This approach to dialogue is not new in debate on N&N related risks and concerns, and its relevance is undisputed. It emerges in different forms in initiatives organised by several organisations over the last few years. [9] A distinctive feature of FramingNano is bringing together, within the same dialogue process, different categories of stakeholders. These stakeholders have different expertise, roles, and attitudes on the issues raised by N&N, and FramingNano will thus gather a comprehensive picture of how different positions can be compared to be one another and, ultimately, balanced.

The assessment of approaches under consideration for the governance of nanotechnologies – and the attitude and opinion of stakeholders with respect to these approaches – is a further pivotal element in starting to develop the Governance Platform.

Several initiatives exist or are being proposed for tackling the problem of effective regulation and governance of nanotechnologies. A set of instruments, listed below, has been identified:

- *Knowledge gathering*: Initiatives aiming to increase knowledge of EHS issues and (to a lesser degree) ELSI. Their scope includes the improvement of methods for risk assessment and risk management; differentiation and prioritisation of nanomaterials and nanotechnology applications with respect to health and safety issues; and the identification and discussion of the most relevant ethical and societal issues.

- *Self-regulation / voluntary measures*: Government authorities, industry and other stakeholders are developing different types of self-regulation and voluntary schemes for risk assessment based on the present status of the regulatory situation, so as to ensure a basic level of trust amongst different stakeholders.

- *Command / 'hard' regulation*: Regulatory bodies have started to develop expertise and the technical knowledge to cope with nanotechnology. In a process which could potentially lead to the development of specific provisions for nanotechnology, they have been evaluating the applicability of existing regulation and whether this has need of adaptation.

- *Transnational efforts*: Standards bodies and international organisations have developed initiatives which aim to define and build international approaches on the management of nanomaterial risks and the harmonisation of standards and guidance on these.

- *Setting-up of a dialogue among all stakeholders*: Initiatives by public authorities and a number of international bodies have sought to disseminate information and promote stakeholder dialogue.

Specific regulations for nanomaterials and nano-related products are still rare, and, consequently, these applications fall under the scope of existing regulatory schemes. Nevertheless, when compared to the situation a few years ago – when there were two mutually incompatible views of regulation: a self regulating *laisser-faire* model and a push for a total moratorium – ongoing debate and attitudes are broader and more articulated. This is indicated in Table 2. [10]

Table 2 - Positions of stakeholders with respect to regulation of N&N

Position / Opinion	Policy makers	Business	Researchers	CSOs
The existing regulatory situation is adequate. If scientific evidence indicates the need for modification, the regulatory framework will be adapted.	+	+		
Specific guidance and standards must be developed to support existing regulations when dealing with N&N, but the existing regulatory situation is generally adequate.	++	++	++	
Regulation should be amended (on a case by case basis) for specific N&N, above all when a high potential risk is identified. A precautionary approach is envisaged.	+	+	++	+
The existing regulatory situation is not adequate at all. Nanomaterials should be subject to mandatory, nano-specific regulations.				++

9 To cite a few: The International Dialogue Meetings on N&N development; The EC Safety for Success Dialogue Series; The NanoRegulation Conferences in Switzerland; The International Risk Governance Council dialogue on Nanotechnologies; the Nano Dialogue 2006 – 2008 in Germany; and several events organised over the last few years by the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the Woodrow Wilson Center for Scholars in the USA.

10 For further details on this table please refer to the *Mapping Study On Regulation And Governance Of Nanotechnologies*, FramingNano Project, January 2009 – www.framingnano.eu

A regulatory scheme which ensures the safety of nanotechnologies without hampering their development should negotiate these positions. FramingNano is moving in this direction by developing an open platform to promote debate amongst informed stakeholders.

Shaping the debate

An assessment of the expectations and needs of stakeholders has been organised based on the current state of the art, with the objective of defining a model for a Governance Platform which gives guidance, as indicated above, at four specific levels (technical and organisational, institutional, trans-boundary, and communication and dialogue).

A multi-step approach has been used to collect stakeholder opinion:

- An electronic first-round Delphi questionnaire designed to identify in broad terms the key themes considered most important and relevant by stakeholders;
- A multi-stakeholder workshop, at which members of representative stakeholder organisations have the opportunity to provide direct input on the consultation process;
- A second-round (written) Delphi questionnaire, designed to elaborate findings from the first round and to enable stakeholders to comment on the themes identified.

This process has gathered responses from a range of stakeholders with an interest in the governance of nanotechnologies. The multi-stakeholder workshop allowed the presentation of a wide range of perspectives, and was organised as an open discussion geared around the results of the first round of the Delphi questionnaire. This was particularly effective in engaging with stakeholders, weighing up their different positions and attitudes, and collecting inputs on relevant issues.

As is typical for this kind of survey, a set of qualitative opinions and proposals (rather than a statistical analysis of a dataset) was collected and will be further aggregated and elaborated during the framing phase of the project.

Some (preliminary) highlights, relating to the governance platform, from the consultation are reported in the following paragraphs.

In terms of engagement of stakeholders in deliberative processes, project experience highlights that focused and clear objectives, the identification of relevant stakeholder groups, and good dissemination and promotion of the process are essential factors. However, other elements relating to the peculiar nature and complexity of the topic under consideration also affect stakeholder engagement.

As noted earlier, attention (in the first place) was focused on 'active' or 'informed' stakeholders; those, in other words, who are well aware of the issues relating to N&N development.

Some of these stakeholders, however, are not expert (in the strict sense) on the topics addressed by the project. Their knowledge and expertise might be focused on specific R&D or business topics, but is only loosely related to EHS, ELSI or regulatory issues of N&N. Even though interest in these aspects is generally high, the difficulty of giving concrete inputs and of engaging in sensitive and delicate debate could lead some of them to opt for an attitude of 'wait and see'.

Moreover, it is also a possibility that some stakeholders will consider that their participation in such a dialogue (and the ensuing public recognition of their use of nanotechnology and its potential risks) could have a negative impact on public perceptions of their businesses. As a consequence, they may not give complete information on their activities or, indeed, may not participate at all.

It is thus important to recognise that a lack of response is not necessarily linked to low interest or involvement in the activity and content of a deliberative process. Instead, speculative 'hidden positions' of stakeholders can be developed.

First, then, the results of the deliberative process should be carefully analysed with regard to the type of stakeholders who contributed, so as to understand and evaluate any missing information or positions.

Second, it seems likely that more has to be done in terms of promoting initiatives which attempt to overcome the 'wait and see' attitude and which foster the input of all relevant stakeholders to the definition of appropriate models for the governance of nanotechnologies. This is important given that a lack of feedback from some stakeholders may result in unbalanced decisions.

Stakeholders, and in particular businesses, should be made aware that, as shown by past experiences with other technologies, early and appropriate governance actions are essential in ensuring the success of a technology, and that proactive behaviour helps to avoid the development of burdensome and impractical regulatory actions. The definition of shared, widely acknowledged models and practices around EHS issues and ELSI aspects of nanotechnologies will also be important in avoiding the development of a patchwork of individual solutions at national and local levels.

In conclusion, in terms of a general methodology and set of principles that should underpin dialogue and communication initiatives amongst different groups of stakeholders, key requirements confirmed by the consultation are:

- Fostering communication between the main players;
- Providing sufficient means of communicating, and pursuing communication;
- Enhancing the communication of scientific findings and what they mean;
- Clearly differentiating between different risks, concerns, nanomaterials and applications;
- Having clarity on priorities and actions to be taken (timeline, expected progress and results, failures and achievements);

- Clearly pinpointing roles, responsibilities and leadership in the decision-making process;
- Maintaining the independence of those communicating with the public.

Framing the Governance Platform

The Governance Platform (GP) is to be designed and developed through a process of framing information and opinions collected, with the final objective being to propose actions and recommendations at different levels to policy makers and other stakeholders involved in N&N development. The GP refers to the four priority areas outlined earlier, in order to:

- Clarify objectives that could or should be achieved, in terms of their importance, urgency and interdependency;
- Define operative goals, concrete measures and responsibilities;
- Propose activities and fundamental conditions necessary for the successful application of these measures.

The framing phase will be a combination of desk-based activity and various participatory processes which gather inputs from both 'expert' and 'non expert' stakeholders (see Table 3).

Conferences at the national level are foreseen as taking place after the definition of the Governance Platform, so as to prompt debate on national N&N governance and to promote action based on the GP.

Table 3 - Activities framing the Governance Platform

Activities	Results
Desk analysis	Evaluation of information gathered in the previous phases of the project.
Expert workshop	Review of the first draft of the Governance Platform with the project Advisory Board and other selected experts.
Desk analysis	Preparation of the second draft of the Governance Platform.
International Conference	Discussion of the second draft of the Governance Platform.

Elements of the identification of content and objectives useful for further deliberative processes on N&N are currently emerging from the framing phase. Some highlights from this, which are likely to be important in the development of the governance platform, are reported below.

With regard to concerns about EHS and ELSI, the consultation has underlined the need for a clear indication of the balance between the risks and benefits of nano-related products currently being developed.

Public acceptance can, in fact, vary drastically with respect to the balance of risks and benefits, in a way often related to the field of application. In sectors such as foods, cosmetics, or products for children, many stakeholders view any potential risks associated with using

nanotechnology as automatically outweighing potential benefits. In contrast, in sectors such as health care, people are willing to accept high risks in exchange for benefits which are otherwise not attainable.

The debate about the potential risks of nanotechnologies is currently mainly focused on the EHS issues associated with engineered nanomaterials – an emphasis which is heightened by the fact that nano-related products are already surfacing on the market. Stringent research efforts towards better characterisation of engineered nanomaterials and the determination of their effects on health and the environment are widely advocated.

Apart from legal issues of regulation, which are closely related to the use and production of nanotechnology, ELSI aspects received a lesser degree of attention from stakeholders, though their importance is widely recognised (as discussed in the first FramingNano publication [11]).

It is evident that neither ethical issues or societal concern are clear-cut, as they are often related to potential uses (or misuses) of future applications of nanotechnologies. Accordingly, they should be treated in a completely different way to risks relating to safety. [12] It is understandable, then, that stakeholder opinion on these issues is less well-defined than in the case of EHS, and that it is difficult to give these issues an order of priority.

There is general agreement on principles and values which should guide the development of N&N, and these generally do not differ much from the ones indicated in the EC Code of Conduct. Particular emphasis is given to transparency and responsibility, which are closely related to the need for better information on the use and production of nanotechnologies and to the need for greater confidence in the safety of N&N.

Nevertheless, what does seem to emerge as missing is a clear understanding of the ways to implement these principles and give concrete responses to the ethical and societal concerns identified. This is underlined with respect to the EC Code of Conduct, where improved guidelines and indications of how to implement it are considered essential elements in enabling its use and application.

The debate on ELSI should be more focused on specific issues and applications, so as to help gather concrete statements and opinions. More resources should be dedicated to understanding and defining actions which would translate agreed principles and values into concrete measures.

11 *Mapping Study On Regulation And Governance Of Nanotechnologies*, FramingNano Project, January 2009 – www.framingnano.eu

12 Further insights on possible approaches to ethical reflection on the development of N&N are provided by EU projects such as DEEPEN, NanoBio-RAISE, and ObservatoryNANO.

The debate on **how to manage and sustain a European policy** on N&N is mainly concerned with the adequacy of the current regulatory frameworks (with respect to N&N), the responsibilities of the authorities involved as well as those of other stakeholders, and the level of subsidiarity envisaged. As shown in Table 1, the situation remains controversial, and the governance platform should be able to mediate between different positions. To this end it is considered crucial that there is greater cooperation between regulators, scientists, and industry, so as to share data and information, harmonise procedures, and avoid fragmentation and duplication of initiatives.

In this context, transparency, responsibility and accountability are considered key principles for ensuring that innovation takes place in a safe manner and with the proper level of (voluntary and mandatory) control and legislative intervention.

The question of whether to create a specific regulatory authority for nanotechnologies (at national or supranational level) or to rely on existing regulation is still open, with both options having pro and cons. In the end, the final decision will be taken on political grounds.

With respect to **international cooperation and coordination** of the governance of nanotechnologies, a trans-boundary approach, at the international or regional level, is largely viewed with approval, although it is acknowledged that putting this into place will not be an easy task.

The important role of existing initiatives, such as those brought forward by the Organisation for Economic Co-operation and Development (OECD) and the International Organisation for Standardisation (ISO), was confirmed, though whether their role and structure should become more effective and whether other international organisations should also be involved in the governance of N&N were matters of ongoing debate.

It is worth noting that ISO, and, to a lesser extent, the OECD, are themselves important examples of deliberative processes, being characterised by open, voluntary and consensus-based decision-making. These aspects mean that most stakeholders have a high level of confidence and trust in them, but they are also seen as involving a lack of participation and support, restricted memberships, scarcity of resources, and lengthy approval procedures. For these reasons, the efficacy of such fora is questioned.

Inclusiveness, **communication and dialogue** are the main elements of any governance model for nanotechnologies.

In the first place, this approach favours technical communication along the supply chain of nanomaterials and nano-related products and, more generally, the transfer of knowledge amongst N&N stakeholders. Three levels of possible intervention have been identified by the project:

- Data sharing along the value chain, including labelling of manufactured nanomaterials in products;
- Data sharing between industry and regulatory authorities;
- Inter-agency communication (at regional or international level, and across application sectors).

Initiatives aiming at fostering public engagement were strongly supported by stakeholders, and were seen as a fundamental part of a 'dynamic approach' to nanotechnology governance. These initiatives were viewed as helping to funnel the inputs of different stakeholders into governance schemes. The general concept was of building trust – rather than 'engineering consent' – through meaningful public engagement.

However, two important issues currently undermining these initiatives which need to be overcome were also outlined:

- A lack of convergence on common and effective models of engagement, and duplication and overlapping of activities;
- A lack of clarity about how the results of public engagement initiatives are taken up and used in practice.

The FramingNano deliberative process stressed the importance of these initiatives, but suggested that a serious attempt must be made to overcome their limitations.

Conclusion

In conclusion, a Governance Platform for governing the responsible development of an emerging technology such as nanotechnology must be built around a combination of actions and instruments, and should take a multi-level approach in order to tackle the complexity of technological development.

Cooperation, coordination and communication amongst all the actors involved in nanotechnologies are mandatory in promoting a proactive and adaptive process capable of framing nanotechnological development across known and accepted boundaries (and to avoid the debate becoming entangled in a never ending 'vicious cycle' [13]).

Nano-regulation must be regarded as dynamic, ready to adapt to the evolution of scientific knowledge, applications and public attitudes.

Concrete and effective measures must be defined and related to a meaningful time horizon. Steps must be taken to assure the implementation of these measures and to monitor their results.

Deliberative processes on N&N may be an effective instrument with which to respond to these needs, but any such processes must be sensitive to the dynamics of the situation and build on previous knowledge and experience.

13 See p132, Final Risk Bridge report and IRGC publications on N&N.

5. The future of deliberative processes on nanotechnology

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Introduction

The aim of this article is to discuss the future of deliberative processes related to nanotechnology. Within the NANOPLAT project (FP7: Science in Society) we have evaluated selected deliberative processes, and these evaluations constitute the data for this article.

Since 2004, over 60 deliberative processes have taken place within the field of nanotechnology (Scholl and Petschow 2008). With recent public discourse on Genetically Modified Organisms (GMOs) in mind, initiatives have been taken in many countries to involve citizens and consumers in deliberative processes. Most of them have taken place in Europe, the USA and Australia. They vary substantially as far as both resources and use of time are concerned, but they have in common a bottom-up involvement of individuals in relatively complicated technical matters. But to what degree have they increased the democratisation of science and technology? In what directions might future deliberative processes within nanotechnology be developed?

In considering these questions, we have divided our article into four parts. Firstly we will start with a discussion of the concept of deliberation, discussing questions such as what we mean by deliberative processes. Secondly, we will continue with an overview of relevant deliberative processes, in addition giving more in-depth analyses of selected processes. Thirdly, we will then move to the question of a platform for deliberative processes relating to nanotechnology. What might this platform look like, and who could be responsible for it? Finally, in the concluding section we will discuss a new generation of deliberative processes.

A key theoretical point of departure for our discussion is Ulrich Beck's (1992) work on the 'risk society'. This suggests that today we are to a large extent concerned with *man-made* risks. This does not mean that it is more dangerous to live in modern times – indeed, the opposite is the case. But while individuals in pre-modern times were exposed to threats such as famine, natural catastrophes, illness and wild animals, modern humans worry about 'civilization products' such as toxic waste, nuclear disasters and mad cow disease. Paradoxically, modern risks also often result from attempts at controlling risk, such as when the insecticide DDT – developed to protect crops – becomes hazardous to birds. It is thus often the solution to one problem that ends up generating new risks. Asbestos solved problems in the building and construction industries in the 20th century, as it was non-flammable, but at the same time created new health problems among construction workers.

As Beck theorises, and as recent experiences with technologies such as GM crops indicate, modern citizens have to a large degree lost faith in science. This has been called a crisis of confidence. However, the real crisis is that, to some extent, citizens have no-one else to trust other than scientists, leaving them to fall into what Wynne (1983) called virtual trust, or 'as-if' trust. This too is a peculiarly modern dilemma. To understand the potential risks of emerging technologies such as bio- and nanotechnology, we need what Beck (1986) calls the 'sensory organs of science': although citizens are sceptical about new technologies and

the ability of scientists to predict potential risks, they are at the same time reliant on scientific knowledge as a way of understanding the problems. This means that while we are perhaps more sceptical towards science than ever before, we are also more dependent on it.

Thus Beck (1992) has suggested that new social movements, such as modern environmentalism, will play a decisive role in handling modern risks. Deliberative processes may play a part in these social movements.

The concept of deliberation

The concepts of deliberation and deliberative processes have emerged from theoretical work on deliberative democracy. Deliberative, or discursive, democracy does not have a long history. Originally coined by Bessete in his book *Deliberative Democracy* (1980), the concept can also be linked to the work of Habermas (1989) and his attempts to define a model for public debate. The concept of a deliberative process is, however, not straightforward and is itself certainly not without debate.

For a decision to be called deliberative, Renn (1999) emphasises that it is essential that it relies on the mutual exchange of arguments and reflections rather than on the status of the participants, power, or political pressure. In addition, deliberative processes should be governed by established rules of rational discourse (Elster 1998). The idea behind embracing deliberation as an aid to decision-making is that collective decisions reached through argument may be considered reasonable solutions to given problems, because they are based upon convincing reasons. Thus Renn (1999) argues that deliberative processes are better suited to deal with environmental challenges than representative democracy, based upon majority votes, because deliberation can produce a shared understanding of the problem and of the positions of various groups of stakeholders. Furthermore, deliberation can produce new options and new solutions, and has the potential to document the full scope of ambiguity associated with the problem. (This point is particularly relevant for our project, because in this regard the link between discourses of environmental problems and of nanotechnology seem strong.)

According to Cohen (1989), there are four criteria for ideal deliberation:

- It is *free* discourse: participants regard themselves as bound solely by the results and preconditions of the deliberation process;
- It is *reasoned*: parties are required to state their reasons for proposals;
- Participants in the deliberative process are *equal*;
- Deliberation aims at rationally-motivated *consensus*.

These criteria seem to fit well with Habermas' thinking on the ideal conditions for societal debates, and are relevant for both public and stakeholder deliberation. It will, of course, be difficult to reach these goals and ideals in practice; however, this does not affect their status as 'ideals'.

Putting the operationalisation of these ideals aside, the concept of deliberative processes is further complicated in two ways. The first relates to the degree of consensus, the second to the degree of institutionalisation. It is worth considering the extent to which achieving consensus is the most desirable aim for deliberative processes. Consensus is one possible aim, but another is 'tolerated' consensus – agreement of the different positions of the stakeholders involved in the process. This means acknowledging the value of conflict in deliberative processes, and recognising the reasons for disagreement rather than necessarily finding grounds for agreement. On the other hand, consensus should be distinguished from compromise. A compromise is a product of bargaining, and belongs more to the concept of new governance (see below).

In terms of the degree of formal institutionalisation, the concept of deliberative processes is, to some extent, used with regard to processes with relatively low levels of institutionalisation (such as citizens' panels, public forums and consensus conferences). We would also see the concept as applying to more institutionalised activities such as formal hearings and advisory committees. This means that we would include the European Standardisation process as one important deliberative tool for nanotechnology discourse – one that is particularly relevant for the expanding consumer market. In standardisation work, we find strong elements of stakeholder deliberation combined with citizen involvement. In addition, the outcome of such processes has a large impact on the field. This makes such processes potential candidates for our analysis.

An additional issue is that, while deliberative processes are usually regarded as a supplement to normal democratic processes, they could also be seen as a way of undemocratically bypassing regular representatives of the popular voice. An example of this might be if, despite the official views of consumer organisations, environmental organisations and/or political parties being known, a deliberative process excluding them is arranged as a way of capturing a 'public' voice. We will return to this discussion in our conclusion.

While we would in principle prefer to leave pure research processes out of our analysis, when it comes to subject matter and the formulation of public opinion it is not easy to point to the difference between a focus group research session and a deliberative process. In our opinion it would mainly bear on the strategic positioning of the event: a deliberative process is supposed to have an impact – to influence policy makers directly – while a focus group which is purely part of a research process has a (potential) indirect influence, through the reporting and translation of public voices by the researchers.

A common feature of deliberative processes and focus group interviews which is particularly problematic is that it seems necessary to supply information to participants early in the event, in order to achieve an interesting exchange of views and information. We can easily imagine that the quality and possible bias of this initial information will determine the outcomes of the deliberation to a large degree, and that desired reactions could be produced or manipulated by the organisers. The character of the supplied information would therefore be a relevant consideration in our evaluative criteria. Even without any conscious manipulation, there is a question of how orchestrated the process is. Power,

resources and knowledge will not be evenly distributed, no matter how neutral and unbiased an organiser tries to be, and the way in which this plays out in practice will be relevant to any review process.

The question of who is represented in a deliberative process can also be seen as problematic. On this, we would like to emphasise our interest in at least two types of deliberation: *processes aiming at the representation of a public or 'common' voice, and processes involving stakeholders*, who represent the interests of various 'constituencies' of business or political/organisational life.

Two related concepts: New governance and the stakeholder approach

We will now proceed by discussing deliberative processes in dialogue with two rather similar concepts: new governance and *the stakeholder approach*. These are both part of a new theoretical and political alternative to traditional democratic processes. Classical representative democracy builds upon the ideal of one man/one vote, and envisages political decisions within this numerical democracy being based upon the power of the majority. New governance and stakeholder approaches and deliberative processes (deliberative democracy) offer alternatives or supplements to traditional processes by introducing lobbying, negotiations and consensus driven ideals.

The shift from *government to governance* and to the new regulatory state presents a substantial development in legislation, regulation and public policy in Europe (Lindblom 1977; Majone 1996; 1999). To some degree, it represents deregulation of public policy (in other areas, however, we have witnessed re-regulation). This may, however, vary from one country to another because of different political traditions and the fact that welfare states were developed along different paradigms in the 1960s and 70s.

The main idea behind the concept of governance is to involve stakeholders in taking responsibility for political, economic and judicial developments in societies, in dialogue with political authorities on European, national and local levels. In the White Paper on European Governance for the EU (COM 2001), the document defines the main principles of governance as: *openness, participation, accountability, effectiveness and coherence*. Discussion on European governance has also included notions of *democratic legitimacy* and *subsidiarity* as further important principles. What roles do stakeholders have to play in the regulation of modern nanotechnology? Is it possible to identify these main principles of governance in current discourse on nanotechnology?

In recent literature we have seen that 'governance' and the 'new regulatory state' are concepts which are used in very similar ways to describe the same phenomenon. This new theoretical understanding suggests a more realistic description of what regulation is and how it works; a realisation of the regulatory limits of state authority; and the acknowledgement of the corresponding potential of private actors to block and restrain public policies. It also includes an awareness of the possible positive contributions to public goals and policies of private firms, organisations and associations. More controversially,

it suggests a new normative model of how regulation works, emphasising its interactive and interdependent nature. However, Olsen (2002) argues that formal processes of reform may not always produce precise and stable policy outcomes. One of the reasons for this instability is the fact that not all stakeholders have resources to play the expected part in the political process. For nanotechnology, this might be the case for almost all stakeholders.

Within the food sector we have seen that industry and retailers in some countries have taken independent initiatives to develop standards and health related schemes. These activities, aimed at the enhancement of consumer trust and brand value and at avoiding litigation claims, seem increasingly to co-exist and partly overlap with public regulations in the same area (Marsden *et al* 2000). This kind of private regulation has been named self-regulation, and is increasingly used by the EU to regulate in a number of subject areas, e.g. food safety and environmental standards (see Majone 1999).

Commentators claim that in some countries and some sectors, these private, often retailer-led, initiatives take on responsibilities public authorities would otherwise have to cover. In some countries a pragmatic division of tasks and responsibilities seems to have evolved between regulating authorities and big business, saving public finances and maintaining markets for the companies involved. In this sense, co-regulation (Black 2002; COM 2001) and private interest regulation (e.g. Marsden *et al*. 2000) have been suggested as appropriate terms for this situation. One should perhaps not be too naïve concerning the nature of a process in which business is kind enough to regulate itself, but if, on the other hand, the government decides on goals and ambitions, self regulation might be cost effective.

Standardisation is another potentially important tool within the governance concept. Here representatives from consumer organisations might be said to represent lay or citizen perspectives and interests. European standards have been frequently used in the implementation of community policies. In support of the European Commission's New Approach directives for certain product areas, for example, standards have become voluntary solutions for demonstrating compliance with legal requirements (Gezelius 2002; Tørres *et al* 1994). There has been an increasing focus on the role standards can play in protecting the environment and supporting sustainable development. European standards often deal with aspects of trade, quality and health and safety of products and processes. By additional consideration of environmental aspects, European standards could contribute to the implementation of environmental policies. An interesting challenge to nano standardisation is to decide whether we have to have new sets of rules in order to deal with materials on the nanoscale. In other words: is silver always silver?

What do we mean by a *stakeholder* approach? The 'classical' concept of the stakeholder was developed within management theory on the relationship between business, on the one hand, and their environments, on the other. It was an expansion of the well-known shareholder concept: firms have to take into account not only the interests of their shareholders, but also their stakeholders. In his book *Strategic Management: A Stakeholder Approach*, Freeman defines stakeholders as "any group or individual who can affect

or is affected by the achievement of the firm's objectives" (Freeman 1984). During the last twenty years this concept has been developed in various directions, at least three of which are relevant here:

- First, we have seen the development of 'corporate social responsibility' (Carroll 1999; Windsor 2001), exemplified in the notion that businesses have responsibilities beyond their economic performance and should take into account other interests than those of their shareholders;
- Second, the concept has expanded from business management theory to society. It now integrates the responsibilities of organisations, policy makers, science and consumers (Dentchev and Heene 2003). This expansion has been controversial, but not without success (Scholl 2000);
- Finally, we have witnessed a debate over the categorisation of various groups of stakeholders. The most relevant distinction is between primary and secondary stakeholders: "A primary stakeholder group is one without whose continuing participation the corporation cannot survive. Secondary stakeholder groups are defined as those who influence or affect, or are affected by the corporation" (Clarkson 1995).

Deliberative processes, the stakeholder approach and new governance have one element in common: they all represent an alternative or supplement to representative democracy. While representative democracy is constituted around voting behaviour and the relationship between voters and their representatives, these three new models build their legitimacy "on the degree to which those affected by it have been included in the decision-making processes and have the opportunity to influence the outcomes" (Young, 2000). The importance of this is acknowledged within representative democracies through public hearings and the activities of organised lobbyists, but the other models take the involvement of stakeholders further.

However, it is also possible to identify differences between deliberative processes, on the one hand, and representative democracy, the stakeholder approach and new governance, on the other. The three last models are all constructed around majority decisions or bargaining solutions based upon the power of the majority, while deliberative democracy's ideal is decision-making based upon arguments and public discourse.

Review of two generations of deliberative processes on Nanotechnology in Europe,

In the following we present two generations of deliberative processes on nanotechnology: a first 'wave' of public engagement processes launched in the years 2004 to 2005; followed by a second wave beginning in 2006 and running through to processes conducted in 2008.

First Generation Deliberative Processes on Nanotechnology

As early as 2004, the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) held a one-day workshop with community members, nanotechnology specialists, CSIRO staff, and government representatives to explore citizens' views on the social, economic and environmental implications of nanotechnologies (the Bendigo Workshop on Nanotechnologies). Discussions in working groups were stimulated by scenario kits and revealed a mix of optimism and concern among the participants with respect to nanotechnologies. Their benefits were particularly appreciated in the context of enhancing socioeconomic well-being and environmental sustainability (Mee *et al* 2004). CSIRO used the findings to draft a 'community issues checklist' which helps researchers and research planners reflect on the social, economic and environmental issues linked to nanotechnology from the citizens perspective.

As a follow up to the Bendigo community engagement workshop, CSIRO organised a Citizens' Panel in Melbourne in December 2004 (Katz *et al* 2005). Participants were citizens from the local community and civil society organisations. In the morning sessions, the presentations of six invited speakers were discussed by the lay panel. In the afternoon, three break-out groups, taking the roles of community, industry, and government, discussed the issues further and formulated group positions as a response to the question 'What statement will Australia make to the United Nations Forum on Nanotechnology in 2006?'. Participants were, amongst other things, concerned about ownership and control of emerging technologies, the adequacy of regulation for nanomaterials, and the social divides that nanotechnology might generate. They were in favour of any nano-application contributing to the decoupling of resource consumption and economic growth and they stressed the need for democratic accountability and transparency in science and technology research and development. CSIRO used the findings of the Citizens' Panel and the Bendigo workshop to develop recommendations for nanotechnology research and future social research around nanotechnology.

The same year the Danish Technology Board completed a qualitative survey of Danish citizens. [2] This exercise aimed to explore public participants' attitudes toward nanotechnology and to stimulate public discourse. The 29 participants in this citizens' nano conference were ordinary people from the Copenhagen area without any prior knowledge of nanoscience and technology. They were sent a preparatory document prior to the event. At the conference itself, two introductory speeches from scientists gave the citizens further familiarity with the topic, and enabled group discussions afterwards. The three-hour event closed with participants filling in a questionnaire. Their responses in the discussions and in the questionnaire revealed a generally positive attitude toward nanotechnologies, but also the wish to increase research on risk and ethics. Research dealing with the prolonging of human life and with nano-enabled improvement of consumer goods met with opposition. The Danish research ministry used the results from this process to elaborate its plan for research on nanotechnology and nanoscience, published a few months later.

The following year, NanoJury UK was established (Gavelin *et al* 2007). [3] Initiated by Cambridge University Nanoscience Centre, Greenpeace UK, the Guardian newspaper, and the Policy, Ethics and Life Sciences Research Centre (PEALS) of Newcastle University, this public engagement exercise aimed to influence policy-making by systematically building and articulating public opinion on nanotechnology. 25 randomly selected citizens formed the jury, although this was also accompanied by a multi-stakeholder oversight panel which monitored balance and fairness of the process and a scientific advisory panel ensuring proper presentation of evidence. The oversight panel recruited the experts ('witnesses') who informed the jury on the relevant matters. During the first half of the process (eight evening sessions of two and a half hours each) the jury explored issues of their choice (young people, social exclusion, and crime in the local community) and in the second half (ten sessions of two and half hours each) they focussed on nanotechnologies. The last few sessions were dedicated to writing recommendations on the future development of nanotechnologies in the UK. The recommendations, each indicating the level of support by the jury, were presented to an audience of policy-makers, researchers, and journalists.

Amongst other issues, the jury called for more openness on public spending on nanotechnology research, for publicly funded research to focus on solving long-term environmental and health problems, and for all nano-enabled products to be tested for safety and properly labelled. With regard to the outcomes of the NanoJury, Doubleday & Welland (2007) conclude that this public engagement exercise on one hand fed into a wider process of policy learning from public dialogue on nanotechnologies – exemplified by the collection, by the British Nanotechnology Engagement Group (NEG), of evidence from engagement projects such as the NanoJury – and the reporting of these to the UK government in 2007 (Gavelin *et al* 2007). On the other hand, the process made the scientists involved more conscious of the wider social and political contexts of nanotechnology research.

The Madison Area Citizens' Conference on Nanotechnology, held in April 2005, represents the first major public engagement exercise on nanotechnology in the United States (Kleinman & Powell 2005; Gavelin *et al* 2007). It was organised by the University of Wisconsin's Center on Nanoscale Science and Engineering and its Integrated Liberal Studies Program. The process took place over three Sunday meetings and involved a group of thirteen citizens from a variety of backgrounds. All participants received background information before the first meeting, which was dedicated to the preparation of a list of questions about nanotechnologies. The second meeting was held as a public forum where seven experts from a range of different fields responded to the questions of the citizens' panel. The final meeting was devoted to drafting recommendations for government, which were afterwards presented to the public at a press conference. Amongst

2 Cf. http://tekno.dk/subpage.php3?article=1093&language=uk&category and Gavelin et al (2007, p.115f.).

3 Cf. www.nanojury.org.uk

other things the recommendations relate to health and safety regulations (e.g. testing of nanomaterials), media coverage and information availability (e.g. databases and product labelling), research and research funding (e.g. increased funding of research into social and ethical implications), and public involvement (e.g. effective mechanisms for citizen involvement in nanotechnology policy development). Whether concrete action has been taken on the recommendations remains unclear (Gavelin *et al* 2007, p.123).

Second Generation Deliberative Processes on Nanotechnology

One year after the Madison citizens' conference, the German Federal Institute for Risk Assessment (BfR) conducted a 'Consumer Conference on the perception of nanotechnology in the areas of foodstuffs, cosmetics and textiles' as part of its risk communication activities. The consensus conference involved a consumer vote on recommendations of how to deal with nanotechnologies in the selected domains (Zimmer *et al* 2007; 2008) [4]. The group of 16 citizens was introduced to the subject through background material disseminated prior to the first meeting and at two preparatory weekends of lectures and discussions. Based on these inputs, the lay panel was asked to prepare a catalogue of questions on consumer-related aspects of applications of nanotechnologies in foodstuffs, cosmetics and textiles. In parallel, the group chose experts for a public hearing from various stakeholder groups (science, public agencies, industry). After this hearing, the group prepared its vote in private deliberation. The next day, the vote was presented to the public and handed over to representatives of the government and civil society organisations.

The vote includes calls for comprehensible labelling, clear definitions, terms and standards for nanomaterials, and for more research into potential risks before nanotechnology is used to a larger extent in consumer products. The vote names foodstuffs as the most sensitive area for the use of nanomaterials. Regarding the use of nanotechnology in cosmetics and textiles, however, the consumers felt that the foreseeable benefits clearly outweighed potential risks. [5] The BfR took a number of initiatives to disseminate the consumer vote among decision-makers. They presented the vote at scientific conferences and to the German 'Nano-Kommission' (a multi-stakeholder board), the consumer committee of the German Bundestag, federal and regional authorities, industrial associations, and to the European Food Safety Authority (EFSA).

An evaluation carried out after the process arrived at the conclusion that the Consumer Conference was, by and large, a transparent process of deliberation (Zimmer *et al* 2008). Consumers and experts had a clear understanding of their roles and the entire process was transparent to outsiders through extensive press coverage. It is less clear, however, what, if any, impact the consumer vote had on decision-making in policy, science, and business. The initiators regarded it as a pilot in public engagement and have not conducted a similar exercise since. [6]

The UK Nanodialogues – a project led by the think-tank Demos and the University of Lancaster – consisted of four experiments in upstream public engagement run throughout 2006 (Gavelin *et al* 2007; Stilgoe 2007). The first, a 'People's Inquiry on Nanotechnology

and the Environment', was comprised of three workshops with a group of 13 residents of East London, and concentrated on the use of nanoparticles to clean up chemically contaminated land. The second, 'Engaging Research Councils', involved citizens, scientists, and Research Council staff, and aimed to explore and discuss the role of public engagement in research planning. The third, 'Nanotechnology and Development', was run as a three-day workshop in Zimbabwe which examined how nanotechnology might help local communities to secure clean water. The fourth experiment, 'Corporate Upstream Engagement', was based on a series of four consumer focus groups discussing nanotechnologies in hair-products, oral care, and food. It was run in cooperation with Unilever and tried to explore the potential of public engagement for corporate research and development.

For the purpose of this paper, the second experiment is the most relevant (Chilvers 2006; Stilgoe and Kearnes 2007). It involved three sessions – two full day meetings and a final workshop on the preparation of conclusions and recommendations. The process started as two groups (one of six full time mothers with children of school age, and the other of eight young professionals with an interest in technology) which were merged into one for the second session. In the first session participants were made familiar with nano-science and technology and with the role of research councils, and prepared questions for discussion with scientists and experts during the second session two weeks later. The final session suffered from poor participation of lay participants from the previous workshops (four out of 14). Due to the experiment's focus on early-stage research the recommendations addressed broader issues of science, technology and society. They advocate clear and easy to understand language in public-science dialogues, the involvement of the public at all levels of the research process, and an intensification of public engagement on nanotechnologies. The evaluation of this second experiment concludes that the process did not meet initial expectations of encouraging public engagement and the delivery of final recommendations:

> Rather than its potential to shape future directions in nanotechnology research per se, it seems that the real value of this experiment lies in its possible influence on learning and reflection within the Research Councils (and other scientific institutions) about the role of public engagement in shaping research agendas in nanotechnology (and other areas of science). (Chilvers 2006, p.11).

4 A similar conference (though without the focus on consumer goods) was held in France the same year. The 'Conference de Citoyens sur les Nanotechnologies' was organised by the Regional Council of Ile de France from early autumn 2006 to late January 2007. 16 participants went through a series of meetings and lectures in order to arrive at a set of policy recommendations.

5 See http://www.bfr.bund.de/cm/245/bfr_consumer_conference_on_nanotechnology_in_foods_cosmetics_and_textiles.pdf for an English version of the consumer vote.

6 However, as a follow-up to the conference the BfR conducted a qualitative and quantitative consumer survey on nanotechnologies (Zimmer et al 2008b).

In Switzerland, a major public deliberation process on nanotechnologies was the publifocus discussion forum on Nanotechnology, Health and Environment (Rey 2006). It was organised by TA-SWISS (the Swiss Centre for Technology Assessment), a publicly funded body for the assessment of emerging technologies with a record of using participatory methods, and funded by the Federal Office of Public Health (FOPH), the Federal Office of the Environment (FOEN) and the Zurich University of Applied Science Winterthur (ZHW). The discussion forum aimed to explore how citizens perceive nanotechnologies in the context of health and environment. The publifocus consisted of four focus group discussions with citizens (53 in total) carried out in different regions in Switzerland (Winterthur, Bern, Lausanne, and Lugano) in September 2006. [7] The groups were recruited to represent gender as well as different occupations, educational levels, and social and political interests. Each discussion group was four hours long, starting with introductory talks from two scientists covering technical and societal perspectives on nanoscience and nanotechnology. After these presentations the participants discussed the topic in two one hour discussion blocks. Right after the event the participants filled in feedback forms which were used for evaluation purposes. The main outcome of the process was a report by TA-SWISS (Rey 2006), the findings of which were fed into nanotechnology policy-making, particularly at FOPH and FOEN.

In all discussion groups hopes of the potential of this new technology, for example in medical and environment-related applications, outweighed reservations. Most concerns were expressed about nano-applications in foodstuffs. Moreover, all participants shared an opposition to non-transparent sales strategies and were concerned about the fact that they already might have unknowingly bought nano-enabled products. Hence, the majority expressed a demand for product declaration and labelling, at least for products that contain engineered nano-particles. The discussion groups also revealed that in their assessment of new technologies people make reference to previous experiences, such as of asbestos and ultra fine dust with regard to possible risks, or of ICT with regard to possible benefits of new technologies.

The National Citizens Technology Forum, conducted in the United States in March 2008 and funded by the US National Science Foundation, was a deliberative process run simultaneously across six different sites in the United States – New Hampshire, Georgia, Wisconsin, Colorado, Arizona and California. It was initiated by the Centre for Nano-technology in Society at Arizona State University (CNS ASU) and co-ordinated by collaborating partners at North Carolina State University (Hamlett *et al* 2008). The process aimed to generate informed, deliberative public opinion on how to manage technologies for human enhancement, in order to demonstrate that non-experts can come to informed judgements on complex issues if they have access to adequate information, and to provide a good example of public engagement that may help ordinary citizens to voice their interests and contribute to shaping public policy. [8] There is no information available yet as to what extent these goals have been accomplished.

At each of these sites, panels of lay citizens – roughly representative of local demographics – were recruited to discuss, debate and give recommendations on converging technologies for human enhancement – i.e. nanotechnology, biotechnology, information technologies, and cognitive science (NBIC). Since these technologies have not yet delivered a wide range

of commercial applications, the process addressed an early stage of technology development. The Citizens' Technology Forum involved a total of 74 citizens completing questionnaires about their knowledge and views on these technologies before and after the process, reading prepared background material, discussing and debating what they saw as the important issues, formulating and asking questions of invited experts in the field, and developing a final report with recommendations for policymakers on how to manage these new technologies. There were face to face meetings within the individual groups on the first and last weekends of the month while interactions across the different groups occurred in nine two-hour online sessions held throughout the month. Researchers from a university at each location served as coordinators and facilitators for the individual groups. The lay citizens received $500 upon completion of the process.

In this deliberative process, all groups shared concerns over the effectiveness of regulation on NBIC technologies and felt that there was a need for more public information. A large majority advocated the greater importance of therapeutic research over that on enhancement, the need for careful monitoring and the development of international safety standards, and formal inclusion of ethical considerations into decision-making on such technologies. Hamlett *et al* conclude that:

> average citizens want to be involved in the technological decisions that might end up shaping their lives. Citizens remain strongly supportive of research that might lead even to transformational technologies, provided that reliable information about and attentive and trustworthy oversight of their development exists. Such information and oversight should not be restricted to environmental health and safety but should include social risks such as equity, access, and civil rights. With the appropriate information and access to experts, citizens are capable of generating thoughtful, informed, and deliberative analyses that deserve the attention of decision makers. (Hamlett *et al* 2008, p.2).

Conclusions on Deliberative Processes on Nanotechnology

The main insights of this review of exercises in public engagement in the domain of nanotechnologies can be summarised as follows.

There is a *wide spectrum of organisations driving public engagement on nanotechnologies*, including academia (universities, research institutions), policy consultants and policy advising research bodies, professional engagement facilitators, public authorities and research councils. Different initiators use these processes to impact on decision-making to different degrees – from informing the general public and/or stakeholders to funding research – which, of course, influences the potential *impacts* of the deliberative process.

7 Additionally, a fifth focus group was carried out with stakeholders from various national organisations and associations.

8 Cf. also http://www4.ncsu.edu/~pwhmds/

There are also different *purposes* behind deliberative processes. They can be about the general identification and assessment of public attitudes towards a certain technology, about experimenting with a new form of public dialogue in order to learn about its potentials and shortcomings, or about informing a specific decision, for example on research funding, from citizens' perspectives. In some cases the idea of *experimentation* with novel forms of public engagement has been important: thus the question of how the process can be organised in an appropriate fashion comes into focus. This reveals that public participation and deliberative processes actually do not follow a given format. Rather, different *forms* of deliberative processes are used, from two hour card games on nanotechnologies to single evening events, focus group discussions of three hours length, and processes running over half a year with three weekends as face to face contact and additional interaction in between these meetings. Accordingly, there is a *variety of tools employed to stimulate interaction* between participants, such as working groups, public hearings, plenary discussions, presentation plus question and answer session, scenario techniques, and card games.

The *results* of the deliberative processes reviewed are numerous. There are *direct and tangible* ones, encompassing votes, recommendations, and reports. *Indirect and intangible* ones include participant learning – such as awareness and sensitivity of the opportunities and risks of nanotechnologies; learning how to manage and employ deliberative processes; and building trust into public risk assessment and management. The *actual impact(s)* of the depicted deliberations, however, are difficult to assess due to a lack of data, a lack of specified goals and a lack of (information about) dissemination activities. If *policy-makers* are only loosely linked – or not linked at all – to the deliberative process the actual impact on (their) decision-making is obviously very small. This appears to be the case in particular for deliberative processes driven by academia (such as the US National Citizens Technology Forum). Thus a *prerequisite* for a significant impact would be the description of a clear avenue for how the deliberative process is going to influence policy-making; often, one encounters no such description.

A platform for further deliberative processes

The following section will present the key concepts used by the Nanoplat consortium in order to define a permanent deliberative platform on nanosciences and technologies (NS&T). It will briefly present the pilot experiment conducted on the theme of 'Food and nanotechnologies', discuss the results obtained, and draw from these results recommendations on possible improvements.

A semi-directed online deliberation among production-consumption-governance actors

An independent promoting institution

The review of recent deliberative process carried out by the consortium shows that whatever form a deliberative process takes, the role of the promoting institution is key to ensuring both information provision for and engagement of the participants, as well as the proper

implementation of each step of the process with the required neutrality and independency. The platform is then activated by an independent third party whose role is to take the initiative in running the process: defining the framework of the deliberation, recruiting participants, and monitoring the process. The Nanoplat platform supports these purposes but suggests that it will always require a 'moderating independent institution' to take a deliberative process forward and to act as a trustworthy and reliable party in the eyes of all stakeholders.

An enlarged discussion among stakeholders

The initial intention of the Nanoplat research project was to facilitate a form of deliberative process between the various players involved in defining, producing and commercialising a particular class of goods based on NS&T. It would thus have concrete power to influence the sector. The interviews conducted in different professional sectors on current deliberation practices show, on the one hand, that a strict focus on a particular product value chain tends to overlap with on-going provider/client relationships and may interfere with business to business strategic discussions covered by confidentiality agreements. On the other hand, they indicate that the platform should focus on promoting deliberation between a larger set of stakeholders, including the authorities responsible for the regulation of particular sectors, professional associations active in the anticipation of regulation, and NGO groups watching consumer interests.

The deliberation may also enable broader dialogues between stakeholders from similar professional sectors in different European countries, as well as exchanges between different professional areas on approaching potential conflicts, anticipating regulation or bringing forward constructive deliberations.

A continuously renewed process

From a participant perspective, involvement in deliberation is demanding both in terms of the time commitment and in the effort – in particular for non-experts – of acquiring and maintaining an updated level of knowledge.

From the perspective of the initiating institution, keeping participants interested requires a continuous stimulation of the debate, similar to the moderation of a round table: feeding exchanges with renewed points of view, focusing on the key issues, and ensuring that all relevant stakeholders groups are aware of the deliberation and have access to it. The notion of a permanent deliberation process should therefore be understood as a process which undergoes continual renewal.

Progressive involvement in social computing tools

From the review of a sample of deliberative process made by the Nanoplat consortium it is reasonable to think that the feasibility of a permanent deliberative process at a European scale will rely on the implementation of an online-based platform. The use of such a platform, and in particular of social computing-like tools, facilitates deliberation between

remote participants in different European countries and supports the different organisational and monitoring tasks of the institution promoting the deliberation. To a certain extent, these tools may enable a deliberative process in which participants autonomously carry out the discussion. But observation of the development of social computing shows that this situation can only be seen after the platform has been in existence for a certain time. In particular it must raise the interest of a critical mass of users, demonstrating benefits for them despite the effort needed to engage with the platform.

A two step deliberative format

The Nanoplat consortium proposed to take Cohen's (1989) four criteria for an ideal deliberation as a starting point to transpose deliberation into an online tool. These criteria are:

- It is *free* discourse: participants regard themselves as bound solely by the results and preconditions of the deliberation process;
- It is *reasoned*: parties are required to state their reasons for proposals;
- Participants in the deliberative process are *equal*;
- Deliberation aims at rationally-motivated *consensus*.

The setting of the platform should also meet the necessary constraints of the proposed deliberation:

- Enabling deliberative exchanges on a European basis;
- Involving high level experts and professionals with highly constrained schedules;
- Providing intensive interactions which take into account both the limited availability of participants and their expectation of getting benefits from their participation;
- As far as possible, minimising the side tasks of organisation, coordination and processing of the information provided;
- Keeping the process 'light' in terms of time requested and financial costs induced. This is to ensure that proper deliberation could be engaged in at any moment when it becomes necessary.

Taking these constraints into consideration, the proposed deliberative process supported by the platform is based on two steps:

Kick-off sessions

The purpose of the kick-off sessions is to prompt the emergence of key issues involving a small circle of experts in a quick interaction process. These sessions are based on short online conferences and a chat-like tool (keyboard based, rather than involving audio or video) which allows short written exchanges between five to 10 participants. The purpose of this is to slow down exchanges between potentially antagonistic parties on the key subjects under debate. On the one hand, the very fact of having to type text in order to intervene in the discussion induces participants to take a more composed attitude.

Body language and tone of voice don't appear, and mood is indicated only through the inflexion of written formulations of positions. On the other hand, written contributions essentially require more rational thinking. Text, then, is perceived as less volatile.

Taken together, the effect of this kind of interaction is to direct participants towards a more reasoned debate, balancing the dynamics of a round table discussion with the argumentation of the written paper and thus meeting Cohen's second criterion. The end result is an eight to 12 page written dialogue which remains available online as evidence of the exchanges and as ready-to-use material for preparing a synthesis for the next step.

Open revision sessions

The purpose of the open revision session is to facilitate the emergence of an agreement within a larger circle of stakeholders.

This second type of session is based on the open access, online revision of the synthesis that emerged from the kick-off sessions. This process is based on a wiki-like tool displaying the synthesis and offering visitors the possibility of editing in order to substitute the initial version with a new one. The tool also offers the history of all previous versions, the possibility of restoring them, a comparison between different versions, and evidence of the changes that have been made. The ultimate purpose is to foster consensus between divergent points of view and interests. The proposed synthesis already tends towards a balanced and reasonable position, in order to meet with all stakeholders' agreement. For visitors, the effort required to disagree is greater than that to agree: the editing of an existing text needs some time and attention, and therefore only consistent controversy will be sustained. Small divergences will induce only fine-tuning of the text or even the acceptance of it as it is. Polemic attitudes and ego valorisation are discouraged. The effect of this type of interaction is to facilitate consensus and thus to meet Cohen's fourth criterion.

The log of visits allows the moderating institution to easily follow the number and type of visitors, and to acknowledge their agreement to the synthesis (whether they make changes to its text or if they simply read the text and approve it). The final result is the last version of the synthesis, which has been agreed by all participants.

Two other important settings of the platform have to be mentioned in order to show how it meets Cohen's final two criteria.

Invited visitors

Stakeholders are invited to take part in both kick-off and open revision sessions. This invitation describes the conditions of the exchanges in generic terms, without mentioning the identity of the stakeholders and so leaving them free from undue influences – thus meeting Cohen's first criterion.

Anonymous participants

Participants receive a specific login and password, but their identity is not disclosed to one another. Their login only states the category of stakeholder they belong to, facilitating mutual understanding during the online exchanges and meeting Cohen's third criterion.

A flexible toolkit for deliberation

The deliberative processes reviewed by the consortium had various purposes, forms, lengths, and sizes, indicating the need to adapt a particular process to specific goals and contexts. The platform is therefore organised as a set of tools which may be used in different ways so as to enable the implementation of different deliberative processes.

The online platform is therefore proposed as a structured toolkit which is available to implement customised deliberative processes (Figure 1). In particular, the deliberative process toolkit offers the following tools, proposed here in the order they have been thought of for standard use:

- *A focused library*

The platform offers a limited library based on a theoretical discussion of the notion of deliberative processes. A related selection of background documents and references, accumulated by the consortium, provides a minimum working framework for deliberative processes.

- *A catalogue of deliberative processes*

A series of case studies documented by the consortium shows a panorama of various recent experiences in terms of form, duration, size, and purpose. In order to facilitate access to and comparisons between these in the online catalogue, three levels of description of the processes can be accessed: a diagram positioning the different processes according to duration and number of participants involved; an intuitive visual map representing the major characteristics of each process in terms of inputs, the process profile, and outputs; and a complete written description of the deliberative process.

- *Support for investigation of production-consumption-governance actors*

Short phone interviews made by the consortium with various stakeholder groups were a useful preparatory phase before approaching the organisation of a deliberative process. The experience gained during the Nanoplat project has been made available online through tips and advice on recruitment of candidates for interviews; good practice in discussion moderation; realisation of a semi-directive interview guide; and a sample of interviews with stakeholders of different groups and from different countries.

- *Briefing documents*

An early goal is to ensure that sufficient basic information on the topic is shared among participants as well as promoters of the deliberative process. A series of short briefing documents and a selection of related reference publications are thus made available on the platform. Since the platform is designed to support deliberation between stakeholders from professional sectors, who tend to already be knowledgeable about the issues, only

light information is provided. It is to be noted that this series of briefing documents plays a role in a first level of consensus between the stakeholders involved, as agreement on the background material should be regarded as a first step towards convergence.

- *Participants list*

A list on a spread sheet allows the institution promoting the deliberative process to follow the different levels of involvement of invited participants, as well as to match their anonymous login with the record of the visits they make to various parts of the platform.

- *A kick-off chat tool*

As described earlier, this tool allows a small number of participants from various stakeholder groups and different countries to interact via a written discussion, raising key topics to deliberate on.

- *A revision wiki tool*

Again as discussed above, this tool allows the engagement of larger numbers and a wider variety of stakeholders in order to review and agree on a synthetic consensus statement as an output of the deliberation.

Figure 1: Beta version of the Nanoplat online deliberative platform

Pilot of the platform on 'Food and Nano'

The Nanoplat consortium ran a pilot experiment with the platform described above focusing on the theme of 'Food and Nano'. The objective was not an exhaustive debate on the topic but rather to experiment with the platform, explore its potential and point to possible improvements.

Briefing documents on the topic were developed in order to introduce semi-directed online debates. They gave the theoretical framework, synthesising the main issues in order to facilitate discussions and give an equal knowledge among kick-off session participants.

Two kick-off sessions were organised, with between four and eight key 'production-consumption-governance' actors being invited to take part in an online deliberative process. Invitations outlined how the debate would be organised, proposed a possible two hour meeting date, and required each invitee to send back some key issues they would like to debate on the topic.

Participants confirmed their interest in taking part. They received an answer by mail stating what kind of stakeholders would be taking part in the debate and what kind of questions would be debated. Participants also received a personal username and password, identifying their role but not their personal identity. Participants were invited to check that they could log on to the platform, and to familiarise themselves with the discussion tools before the discussion session. The guidelines and rules of participation were also highlighted to participants. In particular they were asked to systematically justify ('give reasons for', 'properly explain') their answers.

During the two hour meeting, the participants logged on to the platform, with consortium partners acting as moderators. Six to eight issues proposed by each of the participants were debated for 10-20 minutes each. After the session, a one-page synthesis on each of four initial issues was developed by the consortium

Syntheses for each of the four emerging issues were then posted on the Nanoplat platform via a wiki-based tool. Invitations were sent by mail to the kick-off session participants and to observers of the session, interested stakeholders who were not available for the kick-off session, and a more general range of production-consumption-governance actors. In total 60 invitations were sent, inviting participants to check the text on each of the four issues and eventually to revise the related synthesis. In order to incentivise participation, invitations also explained that the synthesis would be made public.

The consortium monitored the revision process, prompting participation and working to avoid interventions which were thought too radical. 46 persons were invited to take part, with 15 of these logging on to the website over a one week period. The level of feedback was thus 33 % – high, considering the very short time between invitations and the sessions and the challenge of getting time from high level experts and professionals.

This pilot was too short to draw in-depth conclusions on the usefulness of the platform. More piloting on a larger sample of stakeholders and on different topics should be run to confirm the first results. However, it is already clear that an online deliberation platform is a promising solution for promoting regular dialogue between various players on the European NS&T scene and on technology development in Europe and beyond.

In particular:

- The content of the debate on nano and food and the design of the interaction both seem to confirm that the Nanoplat platform provides consistent support for facilitating deliberation between a wide range of stakeholders from different backgrounds and across different countries;
- The level of participation of the experts involved compared with the relatively light effort in engaging them also tends to confirm that a permanent deliberation process on NS&T at a European level can be conducted by one or more independent institutions on a permanent basis and at a relatively low cost.

A number of critical issues have been also identified which would enable the development of this permanent deliberative process from the current results of the Nanoplat research project:

- The current beta version of the online tool should be further developed into a more stable, robust and user-friendly infrastructure;
- A dissemination mechanism, which would give visibility to the on-going debate, should be integrated into the platform. In particular a process of translation of expert conjectures into potential tangible offers on the market has been further developed by the consortium in order to engage with larger publics (see box on the Future Food Dialogue Project);

- A large number of online initiatives – from new products surveys to consumer information and public fora – are already running on the internet. Building synergies with them is key in disseminating debates supported by the platform.

As a potential spin-off of the Nanoplat prototype, a follow-up project called the 'Future Food Dialogue Project' has been developed in collaboration with the Responsible Nano Forum in the UK.

The project objectives are:

- To develop a compelling, yet balanced and rounded approach to presenting the use of technology in food in a consultative though engaging format;
- To engage opinion formers through a consultative development approach in order to inform understanding and communication of some of the potential applications of these technologies in actual products as they may appear on the shelves;
- To understand the views, preferences and concerns of the general public in relation to new technologies in food;
- To communicate these views widely and thus help to ensure that public opinion can make a contribution to the development of technology in food.

One of the deliberation mechanisms proposed in the Future Food Dialogue Project is based on a series of photo-realistic future products elaborated from the hypotheses and opportunities opened up by the progress of NS&T in the food sectors. These tentative anticipations are not meant as an attempt to forecast the future food market, but as stimulation material to foster large stakeholder deliberation on the likelihood and desirability of these conjectures. They consist of a mix of the serious and the naïve and of the reasonable and provocative hypotheses which circulate in the public domain. The purpose of the deliberative debate is to draw tentative lines between realistic futures and fuzzy dreams, and between shared views on expected progress and speculative or misleading Wonderworlds.

Conclusions: The future of deliberative processes.

We have identified three arguments against further development of deliberative processes in nanotechnology in public discourse on such processes:

- New processes will not create more knowledge, but will more or less reveal more of the same;
- The increased use of deliberative processes will raise public expectations, but these expectations will not be met by occasional processes in which no-one has a more permanent responsibility;
- An increased use of deliberative processes will be a threat to numerical and representative democracy. They move the power of decisions from governmental institutions to non-representative processes not designed to make political decisions.

In this concluding section we discuss these three objections to deliberative processes.

More of the same?

In our overview of selected deliberative processes we saw a movement from first to second generations of deliberation. Besides a chronological difference, the distinction between first and second generation deliberative processes on nanotechnologies is most evident in terms of the sophistication of the methodology used.

Second generation exercises are more elaborate than early approaches. To some extent they are also more specific processes: they deal with particular applications rather than the general relationship between science and society. Responsibility is thus moved from the research community to industry. This also has to be reflected by the third generation of deliberative processes on nanotechnology. As we see it, the next generation of deliberative processes need to be even more specific. The reason for this is the fact that we are no longer talking about nanotechnology, but about nanotechnologies. This means that it is not meaningful, from an Ethical, Legal and Societal Aspects (ELSA) perspective, to carry out general processes.

Secondly, during the last few years a large number of nanoproducts have reached the consumer market. More than 1000 products are listed In the Woodrow Wilson Center's updated inventory, ranging from sports equipments to textiles and from cosmetics to car polish products. This is also an argument for more specific processes where strategic areas of the consumer market can become a topic. In the 2004 Danish citizens' consumer conference, participants were not interested in nanotechnological consequences for the consumer market: this would probably not be the case in 2009. One important emerging area is nanofood, and another related area is nanotechnology for food packaging. However, as innovation takes place, other product categories may soon be relevant.

Unfulfilled expectations?

In terms of impact, however, a clear-cut distinction between the two generations is difficult to draw. While there is a lack of knowledge on this topic, the link to political decision-making appears to remain fairly weak.

One of the challenges for deliberative processes is that they create substantial expectations amongst citizens – particularly those who participate in them. What will happen with our input? Who is responsible for the voice of the public in the future? This is a real argument because some of the processes are parts of research projects, and the deliberation ends with the project. Others are parts of public programmes, which also close at the end of the programme. As an example, the Danish Technology Board carried out deliberative processes or stakeholder involvement in 2004, 2006 and 2008, but involvement of citizens was not on the agenda in other years.

Future deliberative processes have to deal with these challenges. We have established a platform for deliberation which has a more permanent character, and this platform may be used in future processes. The simple web-tool developed by Nanoplat makes this possible.

Engagement in social computing processes is facilitated when participants find forms of reward or gratification. The first level of kick-off sessions assumes the form of a round table, allowing participants to debate with peers across Europe and to benefit from the discussion. The second level of open revision sessions gives access to an up-to-date level of consensus between stakeholders.

These two elements are already promising benefits for fostering engagement between participants. To add to these incentives for engaging in the deliberation platform, the Nanoplat consortium proposes adding visual forms of representation (showing scenarios that may result from the deliberative process) to the different levels of written synthesis. The scenarios developed for the platform propose a visual synthesis through the design of some hypothetical products in line with agreements reached by the deliberative process. They are intended to express a balanced position, somewhat challenging compared to the current situation, but reasonable and justified.

The purpose of these visualisations is then twofold: on the one hand, it should stimulate contributors to the deliberative process by showing them a concrete expression of the consequences for the future resulting from what they have agreed. On the other hand, it should facilitate access to the debate by a larger number of stakeholders by translating the debate into the form of concrete – if still hypothetical – products.

A threat to numerical democracy?

We are aware that there may be a key tension within deliberative processes in general and in the development of deliberative processes on nanotechnology more specifically. On the one hand, these processes represent increased citizen involvement in democratic processes. Both in the USA and in Europe we have, over the last decades, witnessed deliberative and stakeholder approaches to the governance of GMOs and nanotechnology. The Danish Board of Technology had developed a model for public involvement in complicated technological processes by the 1980s. This model has created legitimacy around similar deliberative processes.

On the other hand we have also seen a renewed discussion about the relationship between democratic and deliberative processes. In public and scientific discourse we have witnessed an increasing scepticism to many aspects of these deliberative processes. Who participates in and what is the goal of the processes? Within political science this has relevance for classical discussion of numerical democracy and corporate pluralism (Rokkan 1969).

It is possible to identify at least three key challenges for an inclusive, democratic debating and decision-making process on new technology: 1) Knowledge deficits amongst participants and stakeholders; 2) The discrepancy between hypothetical visions and actual commercial

products; and 3) How and if the outcomes of such debates are brought back into decision-making processes.

A lack of knowledge about nanotechnology is also documented in scientific research. This is surely the case for the public in general, but also amongst political actors and other stakeholders. The consequences are that there are a limited number of voices heard in the public debate.

While the predominant representation of nanotechnology in popular science and the media is as fiction relating to micro-machines and assemblers (Crichton 2002; Drexler 1986; Gibson 1996), the presence of nanotechnology in ordinary life is more about carbon nanotubes in sport equipment, nanoparticles in cosmetics, and antibacterial clothing and kitchen equipment. This discrepancy between nanovisons and nanoreality makes it difficult to define a set of themes around which to organise a debate. However, experience has shown that it is possible to engage the public in relatively complicated scientific discourses.

One last challenge is the link to democratic decision-making processes. Is the deliberative process part of a set of inputs to decision-making processes, so that the results are brought directly and formally back into this process? Or is it more a part of research projects, in which the results are inputs into political and scientific discourses but not directly linked to formal processes? We find both kinds of process in our sample.

We have witnessed a critique from both participants and organisers of deliberative processes that it is problematic when deliberation is not a part of formal political processes. It is easy to understand this critique. On the other hand, when we are talking about numerical democracy and deliberative processes, it is also problematic when the results are brought directly back into political processes because of the diversity of the subject, lack of knowledge, and the biased representations within these processes.

The answer to this critique is that we have to distinguish between public discourse and formal decision-making processes. Deliberative processes have given a positive contribution to democratic discourse on science in general, and on nanotechnology more specifically. This represents no threat to democracy – the opposite is actually the case, because it increases public involvement and represents a democratisation of science. However, when we move to formal decision-making, we have to take all decisions within the framework of representative democracy, in which one man and one woman each have one vote.

To sum up our argument: there is a future for a third generation of deliberative processes in the development of nanotechnology. These processes need to be more specifically oriented and more closely linked to decision-making processes. They may gain from using the platform developed within the Nanoplat project. One of the main challenges in the future is the question of who will take the responsibility for running such processes, and independent institutions may be one answer to this question. Deliberative processes represent a democratisation of science, and, as long as we distinguish between public discourse and formal decision-making processes, deliberation represents no threat to numerical democracy.

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6. European trade union and environmental NGO positions in the debate on nanotechnologies

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Introduction

Between 2006 and 2009, European trade union organisations, environmental NGOs and universities cooperated in developing balanced position statements on nanotechnologies. The rapid development of many nanotechnological disciplines, the introduction of nano-products onto the market, and the far reaching effects that these developments may have on our society demand clear positioning of social actors in the debate on nanotechnologies. The European NanoCap project facilitated this capacity building and was able to gain a recognised position in the European debate.

The chosen model for enabling this capacity building proved to be a successful one for both the universities and civil society organisations (CSOs) involved: a process of mutual learning – from universities to the CSOs and from the CSOs to universities – was realised. A broad range of topics was selected in order to understand and discuss nanotechnologies. These concerned technical characteristics, environmental and occupational health issues, social consequences and ethical issues as well as exercises to critically balance the supposed risks against the claimed benefits. The project had a strong focus on engineered nanomaterials and products. More specific topics, not directly related to workers' exposure risks or environmental threats (such as medical nanotechnological applications, nano-electronic applications and military nanotechnology), were largely left outside the scope of the formal discussions.

A key element in the position statements developed by the CSOs is the precautionary principle. This was understood as a precautionary approach which is comprehensible and feasible for industrial manufacturing processes which make use of nanomaterials, as well as for consumers using nanoproducts. It consequently takes into account the possibility of the dispersion of nanoparticles into the environment. Central to this approach is a demand for transparency on the use of nanoparticles in products, resulting in the adoption of the principle 'no data → no exposure'. As a result, there is a demand for obligatory notification of the nanoparticle content of nanoproducts. It is argued that 'nano-reference values' should be used if nanoparticles are used for which no proper risk assessment can be made due to a lack of hazard data.

The development and marketing of so-called 'nonsense' products was also critically considered. Nanoproducts should not be brought onto the market if they introduce new or uncertain risks to health or the environment while any self-proclaimed benefits cannot be substantiated.

The NanoCap project showed that deliberation based on the development of transparent, critical and well-considered positions can lead to constructive results which are acceptable to all stakeholders – including those who apparently oppose each other.

NanoCap [3] was an FP6 (Science & Society programme) capacity building project. It was conducted between September 2006 and September 2009, and involved environmental NGOs, trade unions and universities under the coordination of the Dutch consultancy and

research organisation IVAM UvA. The participating institutions were based in a number of European nations as well as several non-European (North African) countries. NanoCap operated through focused conferences, position discussions and workplace visits. It covered the following topics: technical issues, environmental issues, occupational health and safety issues, ethical issues and benefits of nanotechnology. The project has contributed to a public 'nanodialogue' by means of discussion with members of the trade unions and NGOs involved as well as with parliamentarians, governmental authorities, industry and the public.

The NanoCap project

The consortium

NanoCap was set up as a consortium (represented in table 1) of five European environmental NGOs, five trade unions, five universities, and a coordinator. It worked towards the structured enhancement of stakeholder capacity to understand and critically assess nanotechnologies. The aim of NanoCap was to assist trade unions and environmental NGOs to develop a position on nanotechnologies and to take part in public debate around them.

NanoCap was coordinated by IVAM UvA BV, a Dutch research and consultancy group skilled in dealing with occupational and environmental chemical risks, as well as being experienced in cooperation with civil society organisations. The universities involved took responsibility for the scientific input. They were selected based on a set of complementary expertises relevant to the nanotechnology debate: technical, physical, chemical, environmental, occupational health and ethical. All the trade union groups involved in the project had already worked together in the field of chemical risk policy. The German and Austrian partners acted as intermediaries to the German and Austrian trade unions, and were selected in consultation with these unions as NanoCap partners. The European Trade Union Institute (ETUI), the umbrella organisation for trade unions throughout Europe, also participated. This is a large network with 12 European Industry Federations and 82 National Trade Union Confederations as members.

Three of the environmental NGO groups were associated with the European Environmental Bureau (an umbrella organisation with 143 member organisations in 31 countries), which also participated. The Greek and Baltic NGOs were selected because of their networks around the Mediterranean and Baltic countries.

3 NanoCap: Nanotechnology Capacity Building NGOs and trade unions, FP6, Science & Society Programme. www.nanocap.eu

The starting agreement in the consortium was that there was no obligation to end the project with a single common position representing all of the NGOs and trade unions involved. Each partner was free to leave the project with their own vision and position on nanotechnologies.

The project was strongly focused on engineered nanomaterials and products which contained these. The areas covered were technical issues, environmental and occupational health risks, ethical issues and an assessment of the claimed benefits. Topics such as nanotechnological applications for medicine, nano-electronic applications and military nanotechnologies were largely left outside the scope of the activities organised.

Table 1: Participants in NanoCap

No	Code	Participant organisation name	Country
1	IVAM	IVAM UvA BV	The Netherlands
2	SNM	Stichting Natuur en Milieu	The Netherlands
3	LA	Legambiente onlus	Italy
4	BEF	Baltic Environmental Forum	Lithuania
5	EEB	European Environmental Bureau	EU
6	MIO	Mediterranean Information Office for Environment, Culture and Sustainable Development	Greece
7	FNV	Federatie Nederlandse Vakbeweging	The Netherlands
8	AMIC	AMICUS the Union	Ireland
9	ETUI	European Trade Union Institute	EU
10	KOOP	Kooperationsstelle Hamburg	Germany
11	PPM	ppm Forschung + Beratung Arbeit Gesuntheit Umwelt	Austria
12	UAAR	University of Aarhus Interdisciplinary Nanoscience Centre (iNano)	Denmark
13	TUD	Technische Universität Darmstadt, Institut für Philosophie	Germany
14	KUL	Katholieke Universiteit Leuven, Department of Public Health	Belgium
15	UES	University of Essex, Biological Sciences	United Kingdom
16	ECDO	University of Amsterdam, Expertise Centre Sustainable Development	The Netherlands

Project goals

The main goals formulated for NanoCap were as follows:

- To provide support to environmental NGOs and trade unions in developing positions, based on scientific information, in the debate on nanotechnology;
- To give academic and industrial research and development (R&D) actors tools for developing 'responsible nanotechnology';

- To develop preliminary recommendations for public authorities as to how to address ethics and health, safety and environmental risk issues.

Subsidiary goals were:

- To have environmental NGOs and trade unions better understand nanotechnology and ethics and health, safety and environmental risk issues, so that they can better inform their members and the general public and so that they can make more confident recommendations to governments on these issues;
- To stimulate academic and industrial R&D actors to choose approaches focused on the reduction of nanoparticles, at their source, in their work;
- To stimulate academic and industrial R&D actors to accept an awareness of risk as of similar importance to the design of nanotechnological products as the technology itself.

Main activities

Capacity building took place through eight project team meetings, five subsequent project conferences (see Table 2), workplace visits to companies that manufacture nanomaterials, and participation in national and international discussions on nanotechnologies.

Table 2: NanoCap Conferences

Working Conference	Topics	Organizer
1	Basics of Nanotechnology	ECDO
2	Technical nanotechnological issues. Applied chemistry & physics	UAAR
3	OHS & Environmental Issues related to nanoparticles	UES & KUL
4	Ethical Issues nanotechnologies	TUD
5	Critical assessment of benefits of nanotechnologies	IVAM & TUD

Scientific input

The role of the universities involved in the project focused on enabling knowledge transfer around their specific areas of expertise. The Danish iNano institute provided a solid basis for explaining the properties of nanomaterials and how these differ from traditional materials. Based on this, several comprehensive technical factsheets were composed. The Public Health Department of Leuven University, Belgium, explained the toxicological and occupational health aspects of nanoparticles. The environmental behaviour and risks of nanoparticles, as well as nanometrics, were introduced by the University of Essex (UK) Biological Sciences Department. Existing gaps in knowledge were emphasised. The University of Amsterdam Expert Centre on Sustainable Development highlighted the development of nanotechnologies in the context of wider society, the precautionary approach, and existing legislation on chemicals. They showcased the practical use

of nanomaterials and their related risks through several scientific articles. The Institute for Philosophy, part of Darmstadt Technical University (Germany), highlighted ethical aspects related to the development and use of nanomaterials and nanotechnologies, both now and in the future. Their activities resulted in a comprehensive Ethics Portfolio, highlighting several hot topics in the nanoethics debate. These different topics were further elaborated through discussion with external experts invited to the project conferences.

Action Plans

A key element in the development of positions by the Civil Society Organisations (CSOs – the trade unions and NGOs involved in the project) was the drafting of an action plan by all partners at the start of the project. Within this, partners identified relevant stakeholders and their interests in nanotechnologies, and strategies were worked out for the active exchange of ideas with these stakeholders. Avenues to develop independent positions on the nanotechnology debate were outlined by the CSO partners.

NanoCapMeter

Another key element in the process was the NanoCapMeter, a monitoring exercise carried out half-way through the project as an interim check designed to identify the opinions of the partners on their priorities for the rest of the capacity building process. This check included responses on the items partners ranked as most relevant to the debate; what they thought was missing and needed to be addressed in the project; and what the major drivers and constraints influencing their opinions on nanotechnologies were.

Company visits

One important activity was meetings with industrial actors on the development and use of nanomaterials and on the way industry uses a precautionary approach in practice. The NanoCap team made several workplace visits to sites where nanomaterials are manufactured and used, where they discussed the environmental, health and safety issues around nanotechnology with managers of the companies involved.

Final Conference

The project finalised its activities with the organisation of a European Conference ('Working and Living with Nanotechnologies') in collaboration with the European Parliament body STOA (Science and Technology Options Assessment). The positions of the trade unions and the environmental NGOs were presented and discussed. Representatives from the European Parliament also presented their initiatives for realising the responsible development of nanotechnologies.

Monitoring

The capacity building process was monitored using impact assessment. At the start and end of the project, the ways in which the trade union and NGO partners had formed opinions was evaluated with a questionnaire. The questions concerned the partners' knowledge, their attitude towards nanotechnologies, and the confidence they had in taking part in a discussion on nanotechnologies. At the end of 2008 and the start of 2009, opinion on specific hot topics in the nanodebate was further investigated using an in-depth list of detailed statements and questions. The investigation focussed on the acceptability of voluntary measures compared to binding legislation, ways in which the precautionary principle can be operationalised in nanotechnology R&D, the balance of risks and benefits, and the issue of trust in the nanodebate. The focus was mainly on opinion on the health and environmental risks of engineered inorganic nanomaterials. The results of the two questionnaires were compared and used as background material on the development of nanotechnology in society.

Ethical considerations of nanotechnology

An Ethics Portfolio was developed in order to support the CSOs in dealing with ethical and societal aspects of nanotechnologies, and to provide a tool for reflecting on the phenomenon of 'nanotechnology'. It was set up as an open, loose-leaf collection which invited the inclusion of concepts under discussion or of those concepts that were felt to be problematic by NanoCap members or participants in the workshops. The openness of the portfolio allowed for appropriate accommodation to the quickly changing field of nanotechnologies.

The portfolio offers articles in four different categories: basic ethical concepts (such as speculative ethics), concepts as tools (for example green nanotechnology), case studies (such as 'Magic Nano'), and regulatory issues (including codes of conduct). The category of 'basic ethical concepts' includes concepts that occur regularly in ethics-talk about nanotechnology (such as justice, privacy, speculative ethics, and consequentialism), as well as critical reflections (are these concepts really useful? What do they imply? Who uses them and what for?) on frequently occurring terms such as 'nano-ethics' or 'consequentialism'. 'Concepts as tools' articles help to analyse discourse on nanotechnology (including commentary on visions, fact and fiction, dystopias, utopias, hubris) and to differentiate the interests of stakeholders such as global enterprises, start-up firms, scientists, governments, NGOs, trade unions, and the media. The articles thus seek to develop the position of the portfolio user within a sound conceptual framework. In 'case study' articles, insight is offered on controversial issues, such as the product Magic Nano (the nanoproduct without nano) or the region Grenoble, where militant resistance was mobilised against nanotechnological production. The category 'regulatory issues' discusses concepts which have been introduced to manage the relation between industry, government, employees, political activists and other stakeholders in society. These concepts and institutions include, for instance, observatories which collect, select and disseminate data or codes of conduct of different types.

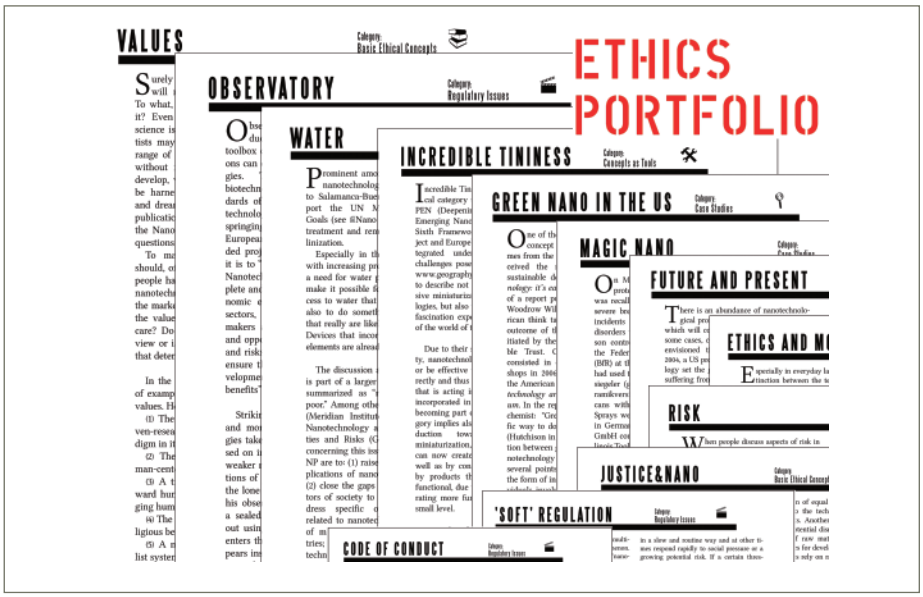
Over the course of the project, the baseline of ethical reasoning became an awareness that there is indeed a need for ethical analysis of nanotechnology and nanotechnologies, alongside a sense that there isn't really anything new beneath the sun. Consequently, some ethicists argue that there is no need for a new label of 'nano-ethics', because all issues are already covered by existing ethics – such as environmental-, bio-, or medical ethics. Others favour a label specific to nanotechnology so as to better keep track of diverse developments. It is, however, more important to recognise that there are political and corporate interests in this labelling or un-labelling. These influence how a technology is perceived in society just as much as any kind of ethical analysis does.

Two further issues were frequently discussed in the project and were key to the ethics portfolio. The first deals with the phenomenon that an important part of nanodiscourse refers to the future – 'could', 'might', 'would' and 'should' are the modal verbs that one comes across most frequently. The ethical debate should, however, not reproduce this drive towards the future. Instead it should deal with relatively close at hand and, above all, well founded predictions of applications if it is not to run the risk of leaning towards far-fetched visions and granting these credibility – a form of debate that was termed speculative ethics. This does not mean that ethics should refrain completely from predictions – this would serve, on the other hand, the critic who claims that ethical analysis is left behind by technological development, always coming too late to have an effect.

The second issue was to distinguish between *nanotechnology* (a mainly discursive phenomenon) and *nanotechnologies* (the different technological and scientific areas involved), and to discuss the question of whether nano-ethics deals mainly with nanotechnologies. The answer to this question is given in the last paragraph of the portfolio sheet 'nano-ethics':

> ...not only discussing aspects of distinct applications of societal aspects is ethics business - also the act of disentangling the complex phenomenon of nanotechnology is an ethical venture itself. It is necessary to establish a common learning process that opens up the programs of nanotechnology for political and ethical discussion. It is advisable to identify basic programmatic strands in the field of nanotechnology. Each of this strands opens up perspectives on scientific approaches and technological visions on the one hand, and on the other hand sheds light on a set of ethical and societal problems.

Figure 1: The Ethics Portfolio



Discussions in the capacity building process

Positioning

The NanoCap project started with an initial question on partners' understanding of nanotechnologies. This discussion questioned the specific role of the partners in critical assessment of nanotechnological development, and the ways in which they should perform this role. It sought to find an adequate way to identify and articulate ethical, societal, political and health and safety concerns, as well as to explore who is asked – or supposed – to play this critical role and for what purposes.

The outcome of this discussion was a sense that it is not the business of one stakeholder group alone – whether politicians, NGOs, industry, trade unions, or philosophers – to set the agenda for nanotechnological development, or to express a critical opinion. All actors in the nanodebate emphasise the importance of broad societal participation and input for guaranteeing balanced and responsible development. Preferably, inputs into this debate should be educated and well-informed.

Mutual capacity building began with the identification of relevant nanotechnological developments (though the NanoCap project specifically limited its discussions to engineered nanomaterials and products, including technical issues, environmental and occupational health risks, ethical issues and the claimed benefits of these). Futuristic developments such as human enhancement were excluded from the core discussions of the NanoCap team.

Uncertainties and ambiguities

A key question for NanoCap was how to deal with uncertainty and ambiguity in managing risks stemming from the use of nanomaterials in workplaces and from the release of nanoparticles into the environment. This brought the precautionary principle to the fore within the discussion, and led to demands for practical solutions to using a precautionary approach into practice.

The chosen approach reflects on one hand 'occupational hygiene strategy thinking', using a hierarchical selection system for source-oriented exposure prevention measures and for environmental emissions. It also takes a source-oriented approach to preventing any release of dispersible nanomaterials into the environment. On the other hand nanotechnological development was also approached from more sociological and ethical perspectives, leading to the identification of relevant stakeholders and interests and to the use of a model of 'collective experimentation' being questioned. This was understood as the opposite of a precautionary approach: the introduction and use of nanomaterials without proper hazard data, risk assessment models or monitoring equipment can be seen as using a whole society as an extension of the laboratory. It thus involves simply waiting to see if adverse effects arise – which may be problematic if suitable instruments to monitor any short and longer term adverse effects are not available.

It is quite clear that the much heralded promise of nanotechnologies to solve fundamental social problems has led to industrial, national and European initiatives to guarantee responsible development (through the use of Codes of Conduct and an emphasis on sustainability and precaution). At the same time, however, many initiatives can be interpreted as a way of paving the road to uninhibited growth of the nano-market. Within NanoCap's discussions, a key question emerged based on this dilemma: if we desire progress in our societies, does a model of collective experimentation help to develop productive strategies towards this and to enable suitable risk management? And if uncertainty is not an empirical but a systematic question, then what are the consequences for the conceptualisation of knowledge, strategy (by government and industry), and public understanding?

If we want to avoid consequentialist reasoning, how can ethical and political reflections on the metaphysical programs of nanotechnology sustain this claim? Further, if we want to make use of nanotechnology as a sustainable program, what kind of practical tools do we need, and what theoretical framing helps to prevent us falling prey to the campaign ploys of politics and business? And what should be the role of CSOs in this?

Within this multi-dimensional debate the NanoCap project was only able to address these latter questions to a limited degree. Discussion on the practical development of a precautionary approach for nanotechnologies therefore largely remained grafted onto conventional risk assessment strategies and well-established, though critical, worldviews.

Binding and voluntary measures

NanoCap CSOs broadly subscribed to the call for the thorough adaptation of existing legislation to materials on the nanoscale, but voluntary measures such as Codes of Conduct were viewed with suspicion. They were thought to have the potential to play a role in raising ethical awareness of academic and (to a lesser extent) industrial researchers, but were not expected to be a good tool for controlling workplace exposure to nanoparticles or preventing nanoparticle release into the environment. Here information was seen as playing a crucial role, with a notification obligation viewed as an important element of any framework for responsible nanotechnology. Notification should oblige a producer of nanoparticles to provide information on the type and amount of nanoparticles used in a nanoproduct. This information should be communicated throughout the supply chain, preferably through using product specific safety data sheets (SDS).

'Good practice' – in the form of generic descriptions of safe working procedures – is frequently suggested to be a valuable tool for workplaces in relieving an employer from performing specific exposure measurements. CSOs are critical of this, and prefer to develop more specific practices. They are not confident that generic 'good practice' is applicable to all workplaces which use nanotechnology: risk assessment must also show that working according to good practice guidelines actually does result in low workplace exposure. In addition, in order to measure 'acceptable' exposures, the CSOs called for a reliable (well-considered and precautionary) reference point. They asked, therefore, for the development of occupational exposure limits (OELs) for specific nanoparticles. If the development of health-based OELs is not possible, due to a lack of reliable data, then they would prefer a precautionary approach in developing nano reference values. This would result in guidance values developed using a worst case scenario.

Combining trust and accountability in the debate

The NanoCap CSOs indicated that the building of trust in the development of nanotechnologies is strongly related to the position and the interests of the institution or organisation communicating this development. They were cautious, for example, about information on the toxicity of nanomaterials which came from industry. While they agreed that it is the duty of industry to generate enough information on the toxicity of manufactured nanomaterials to make reliable risk assessments and to provide chemical safety reports, they were of the opinion that industrial information should be complemented by assessments by independent researchers. Attention should be paid to preventing any risk assessment becoming mixed up with economic interests. The CSOs argued that mutual trust in the nano-debate can only be realised by complete openness on nanomaterials and on where knowledge is currently lacking.

Positioning of the trade unions and environmental NGOs

Both the trade unions and the environmental NGOs developed positions on the development of nanotechnologies based on the inputs generated by NanoCap's university partners and on their own research. This involved a deliberative process of separate meetings of trade union partners and NGO partners, as well as discussions as the complete NanoCap team.

The trade union partners in the NanoCap team discussed the key elements of their draft position as a panel of representatives from member organisations in Europe. This position was further developed by the ETUI at the European Trade Union Confederation (ETUC). In June 2008, at its Executive Committee meeting, the ETUC adopted its first resolution on nanotechnologies and nanomaterials. This represented the position of the European trade unions on nanotechnology. [4] The resolution's key demand is that the precautionary principle must apply to nanotechnologies.

The environmental NGOs followed a similar pathway towards a formal position statement. Their draft position, developed within NanoCap meetings, was discussed with representatives from EEB member organisations (in particular the German BUND) and finally published as the position of the EEB in February 2009, as an EEB paper on nanotechnologies and nanomaterials *Small scale, big promises, divisive messages*. [5]

The different NanoCap CSOs came from very different national contexts, and the positions developed within NanoCap were adapted to these different national debates. As a result different national positions were developed, in some cases with far reaching consequences.

Trade unions on nanotechnologies

The trade unions focused on the legislative aspects of nanotechnologies, and in particular on their relation to the chemicals legislation REACH and to regulations on the design of safe workplaces. They took the precautionary approach as their starting point and proposed a series of concrete measures to realise transparent risk information for the workplace. Transparency and openness on nanoproduct composition are key elements.

Box 1 presents an extract from the ETUC resolution. This is followed by a short description of national developments around the trade union input in the nanotechnologies debate.

Box 1: Trade Union position statement

The trade unions' position – the ETUC resolution

Nanosciences and nanotechnologies are new approaches to research and development (R&D) that aim to control the fundamental structure and behaviour of matter at the level of atoms and molecules. These fields open up the possibility of understanding new phenomena and producing new properties of matter that can be utilised in virtually all technological sectors.

The ETUC is convinced that nanotechnologies and manufactured nanomaterials might have considerable development and application potential. These technological advances and the new jobs they might bring may address peoples' needs, help make European industry more competitive and contribute to the achievement of the sustainable development goals set out in the Lisbon Strategy.

However, the ETUC notes that significant uncertainties revolve around both the benefits of nanotechnologies to our society and the harmful effects of manufactured nanomaterials on human health and the environment. The development of these emerging technologies and the products from them also poses huge challenges to our society in terms of regulatory and ethical frameworks.

The ETUC considers that if the past mistakes with putatively 'miracle' technologies and materials are not to be repeated, preventive action must be taken where uncertainty prevails. This means the precautionary principle must be applied. This is the essential prerequisite for the responsible development of nano-technologies and for helping ensure society's acceptance of nanomaterials.

The ETUC welcomes the European Commission's action plan 2005-2009 on nanosciences and nanotechnologies, which is based on the safe, integrated and responsible strategy put forward in its 2004 communication. Nevertheless, our analysis of the first Commission Report on its implementation over the period 2005-2007 reveals large gaps and deficiencies, which ought to be eliminated without delay.

Where investment in R&D is concerned, we see and note a gross imbalance between budgets for the development of commercial applications of nanotechnology and those for research into their potential impacts on human health and the environment. The ETUC calls for at least 15 % of national and European public research budgets for nanotechnology and the nanosciences to be earmarked for health and environmental

4 See http://www.etuc.org/a/5163 for the full text in English and French.

5 See http://www.eeb.org/.../2009/090228_EEB_nano_position_paper.pdf for the full text.

aspects and to require all research projects to include health and safety aspects as a compulsory part of their reporting.

The ETUC considers that a standardised terminology for nanomaterials is urgently needed to prepare meaningful regulatory programmes. In particular, ETUC calls on the Commission to adopt a definition of nanomaterials, which is not restricted to objects below 100 nanometer in one or more dimensions. This is important to avoid many nanomaterials already on the market to be left out of the scope of future legislations.

The ETUC is concerned at the holdup in the Commission departments' examination of the current legislative framework and its identification of the regulatory changes needed to address workers' and consumers' concerns about the health and environmental implications of nanomaterials.

After the asbestos scandal which cost the lives of hundreds of thousands of workers, and when the EU has recently introduced new legislation on chemicals that puts the onus of proof onto manufacturers, the ETUC finds it unacceptable that products should now be manufactured without their potential effects on human health and the environment being known unless a precautionary approach has been applied and made transparent to the workers.

In particular, ETUC considers that manufacturers of nano-based products should be obliged to determine whether insoluble or biopersistent nanomaterials can be released from them at all stages of their life cycle. In the absence of sufficient data to prove that those released nanomaterials are harmless to human health and the environment, marketing should not be permitted.

The ETUC therefore demands full compliance with REACH's 'no data, no market' principle. It calls on the European Chemicals Agency (ECHA) to refuse to register chemicals for which manufacturers fail to supply the data required to ensure the manufacture, marketing and use of their nanometer forms that has no harmful effects for human health and the environment at all stages of their life cycle.

Strict application of this principle must be used to encourage industry to fill the gaps in the scientific knowledge about the safety of engineered nanomaterials, especially the fate and persistence of nanoparticles in human beings and the environment.

The ETUC calls on the Commission to amend the REACH regulation so as to give better and wider coverage to all potentially manufacturable nanomaterials. Nanomaterials may indeed evade the REACH registration requirements because they are manufactured or imported below the threshold of 1 tonne per year. The ETUC demands that different thresholds and/or units (e.g. surface area per volume)

are used for registration of nanomaterials under REACH. The ETUC considers that the obligation to produce a chemical safety report for production volumes only above 10 tpa is another loophole that will allow many manufacturers or importers to avoid doing a risk assessment before putting nanomaterials on the market. The ETUC wants a chemical safety report to be required for all substances registered under the REACH regulation for which a nanometer scale use has been identified. The ETUC also demands Annexes IV and V of REACH (exemptions from registration) currently under revision not to permit manufactured nanomaterials to evade the REACH requirements.

Workers engaged in research, development, manufacture, packaging, handling, transport, use and elimination of nanomaterials and nanotechnology products will be most exposed, and therefore most at risk of any harmful effects. The ETUC therefore demands that health and safety at work must have priority in any nanomaterials surveillance system. There is a great need for training, education and research in order to allow health and safety specialists (e.g. labour inspectors, preventive services, occupational hygienists, company physicians) preventing known and potential exposures to nanomaterials.

The ETUC calls on the Commission to amend Chemical Agents Directive 98/24/EC, which it believes, does not afford adequate protection to workers exposed to substances for which there are gaps in our knowledge about their toxicological properties. Employers must be required to implement appropriate risk reduction measures, not only when known dangerous substances are present in the workplace, but also when the dangers of substances used are still unknown. This would enable all manufactured nanomaterials to be covered, along with many other substances that carry unknown health risks to which workers are exposed.

Workers and their representatives (e.g. safety reps) must be fully involved in risk assessment and the selection of risk management measures without fear of retaliation or discrimination. Moreover, they must be informed of the nature of the products present on their work places. The ETUC therefore considers that safety data sheets must clearly state whether nanomaterials are present. If toxicological or ecotoxicological data are missing, that must also be indicated in safety data sheets. The ETUC considers that significant efforts must be made without delay to prevent occupational exposures to already known manufactured nanomaterials. That will involve, in particular, exposure monitoring, health surveillance for workers and appropriate training.

The ETUC believes that consumers also have the right to know what is in a product. In many cases, manufacturers have published no information on tests done on nanotechnology products and their health hazards, or have not labelled consumer products as containing nanomaterials. Not being fully informed prevents the public from making informed decisions about the purchase and use of such products.

The ETUC wants all consumer products containing manufactured nanoparticles, which could be released under reasonable and foreseeable conditions of use or disposal to be labelled. In addition, as part of the precautionary approach, ETUC calls on Member state authorities to set up a national register on the production, import and use of nanomaterials and nano-based products. Those measures would make it easier to monitor any human or environmental contamination and to identify where responsibility lay for any harmful effects.

The ETUC believes that Industry Voluntary Initiatives and Responsible Codes of Practices may serve a useful purpose pending implementation of the necessary changes to the current legislative framework and/or the introduction if need be of specific new European legislation to support responsible nanotechnology development. However, the ETUC is prepared to endorse such initiatives only if the signatories undertake to involve workers' representatives in their design and monitoring, if there is an independent and transparent system for assessing compliance (e.g. by involving labour inspectorates) and if sanctions are foreseen in case of non-compliance. In addition, the ETUC demands that companies, which adopt such systems, disclose information on the hazards and risks associated with their products and commit themselves to be fully accountable for liabilities incurred from their products. Finally, since nanotechnologies have the ability to profoundly alter the social, economic and political landscape of our societies, it is essential that all interested parties have a full say in the discussions and decisions that affect them. The ETUC therefore calls on the European Commission and Member State governments to commit sufficient funds to ensure real civic participation in the current debate on these new technologies.

The ETUC resolution is currently playing a role in the deliberations of fora such as the European Parliament, the European Commission, OECD and REACH.

The Netherlands

Supported by the NanoCap coordinator IVAM, the Dutch Trade Union FNV focused its efforts on realising the trade unions' demands with regard to activities by the Social Economic Council (SER). By request of the Ministry of Social Affairs, the SER advised on how to operationalise a precautionary approach in working practice. The trade unions were able to reach full agreement with the employers organisations on a precautionary approach for a safe workplace. In March 2009 the SER advised the minister on safe use of nanoparticles in its *Advisory report 09/01 - Nanoparticles in the Workplace: Health and Safety Precautions*. The three ministers of Social Affairs, Environmental Affairs and Economic Affairs gave reactions to this advice, leading to an intense discussion in the Dutch Parliament and resulting in several motions in the Parliament. The following three motions were accepted by a majority of the Parliament in July 2009:

- Motion on notification obligations (notification regarding the nanoparticles contained in products);
- Motion on nano reference values (to aid risk assessment in the case of health-based references not being available);
- Motion on speeding up risk research.

The consequences of bringing these motions into practice are expected to be significant in the development of discussions in the Netherlands, as well as in Europe generally, on the risks of nanoparticles.

Austria

In Austria existing union commitment to action on nanotechnologies gained additional momentum when the ETUC resolution on nanotechnology and nanomaterials was adopted. The trade unions used parliamentary motions to demand that the government prepared an Austrian nano action plan as soon as possible. A parliamentary motion on positions on nanotechnology and on the activities of two ministries was presented in June 2008 by the acting secretary of the ÖGB OÖ Provincial Executive (who was also a member of the second chamber of the federal parliament and who had links with NanoCap) along with other board members of the ÖGB, in order to raise the profile of nanotechnology-related workplace risks with members of both houses of the Austrian parliament. Both the Ministry of Environment (responsible for chemicals in general) and the Ministry of Innovation and Technology (responsible for nano R&D funding) support public communication of nanotechnological risks. Both Ministries declared their willingness to fund health and safety research on nanotechnology as an accompaniment to other R&D – though to a comparatively minor degree. With respect to nano-specific Austrian regulations, the government indicated that it was waiting for the results of the ongoing discussion process within the European Union.

Germany

German trade union officials potentially interested in nanotechnology were targeted in a number of different ways, with information on certain aspects of nanotechnology offered to them throughout the project. The project observed – from the exploratory phases of the NanoCap project onwards – that trade union officials and works councillors were reluctant to get involved in a new and highly specialised subject. This reluctance stems from an overload of tasks set against a backdrop of shrinking resources, as well as the challenge of tackling a complex subject which may become relevant in the future but which is not yet an obvious controversy at the workplace level. With the help of the NanoCap project, issues around nanotechnologies (and in particular critical responses to these) have been given visibility amongst trade union experts, officials and works councillors. Although these contacts were initially aimed at the trade union national working group on research and technology, this group were not prepared to include the issue in their portfolio of themes. In contrast, the national working group on hazardous substances took the issue on board, and trade union officials working on occupational health put it on their agenda.

As spin-offs of the NanoCap project, the German trade unions are now represented in the NanoCommission and on the NanoDialogue. They also ensured that occupational health and safety aspects of nanomaterials were put on the agenda of the AGS (Ausschuss für Gefahrstoffe).

In conclusion, it seems that activities of German trade unions with regard to nanotechnologies will remain rather limited unless they are forced to expand by the societal debate at large. In particular, if that debate gains momentum and develops new qualities then the issue may re-enter the agenda of trade unions.

Ireland

The Irish trade union AMICUS played a key role in developing policies, positions and expertise to address the health and safety concerns expressed by workers in trade unions and other fora. The experience and capacity gained from involvement in the NanoCap Project enabled AMICUS/UNITE to play an active role in the development of a National Strategy on the use of nanomaterials in R&D, industry and the workplace by the Irish Health and Safety Authority's Technical and Scientific Advisory Committee (a tripartite body of employers, government representatives and trade unions). The working group presented the final document to the Technical Standards & Safety Authority on 8 September 2009. NanoCap also facilitated AMICUS's participation in the (UK's) Royal Society forum on the development of a Responsible Nano Code, in 2007 and 2008.

The environmental NGOs and nanotechnologies

The key elements of the NGOs' position statement are the ideas of precaution and sustainability. Openness, transparency, and public engagement in the nanotechnology debate are also important demands. Adaptation of the existing regulatory framework to the materials on the nanoscale is viewed as essential.

Box 2 presents an extract from the EEB position paper. This is followed by a short description of national developments concerning NGO input into debate on nanotechnologies.

Box 2: EEB position

EEB position paper on nanotechnologies and nanomaterials – Small scale, big promises, divisive messages

(...)

EEB's demands for sustainable governance of nanomaterials

In EEB's view, nanomaterials need to be managed according to fundamental principles of sustainable and responsible development. These fundamental principles take as starting points the precautionary principle, a strict regulatory regime, environmental and human health protection and safety, public participation, a lifecycle approach and the inclusion of broader societal impacts in governance mechanisms.

To date, the EEB has not been pleased with the European Commission's unfocused reaction to the development of nanomaterials. The following demands, if implemented, would provide a more credible, coherent and comprehensive approach to the governance of these novel technologies. Such an approach would enable the research community and industry to better target future applications of nanotechnologies within publicly agreed sustainability parameters.

EEB demands that no further market introduction be allowed for products containing manufactured nanomaterials, which could lead to exposure of consumers or uncontrolled release in the environment. Such a restriction should be put in place until appropriate impact and safety assessment tests are developed that provide scientific proof that these materials and products are adequately safe to human health and the environment. Those products already on the market should be regulated according to the REACH approach of 'no data, no market', and should therefore be removed from commercial circulation.

The following additional demands would help establish a policy and regulatory framework on nanomaterials:

1. Develop a pre-market registration and approval framework

The fast-moving development of the types and uses of nanomaterials requires a regulatory framework that can anticipate the safe management of future applications in advance of their availability on the market. Such a framework would help to better identify future developments in these materials and their uses, whether at early research stage or in later near-market stage. The framework should require registration of public and private research, test-based assessment and approval of near-market uses of nanomaterials. This information should then be put into a publicly available inventory, as part of a coherent and comprehensive policy framework on nano (see Demand

number 3). This would serve to identify what possible future uses of nanomaterials could be developed, systematically assess what products are proposed for placement on the market and would help ensure swifter and more targeted management of these.

We therefore call on the European Commission to create a publicly available inventory for public and private research and demand test-based assessment and approval of materials in near-market-use stage. Such an inventory needs to be one of the elements of a policy and regulatory framework. This EU-wide inventory should be fed into by Member State level inventories, to avoid lack of harmonisation and duplication of efforts, while providing citizens important country-specific information immediately available in their national language.

2. Undertake public consultation on technological innovation, including nanotechnologies and nanomaterials

More attention has been devoted to technological innovation than to social innovation, including public participation in decision-making and the development of more democratic decision-making procedures. In light of increasing focus on innovation, and eco-innovation in particular, as a means of achieving competitiveness, more efforts are needed at EU and national levels to legitimately incorporate public opinion in political decisions. For example, public opinion should be sought systematically on the needs for some innovations, as it should not be assumed that they will all deliver great enough social advantages to justify greater risk exposures.

Some Member States have already begun to hold national nano dialogues, with varying levels of public involvement, objectives and scope. At EU level, DG SANCO has held two stakeholder dialogue events and more are planned on a yearly basis, but without clear objectives, a timetable, or a relationship between these events and official decision-making processes. Structured gathering of public opinion of novel technologies and their uses is essential for their sustainable management, particularly in developing a regulatory framework that reflects these opinions. Therefore, an EU-wide public debate, organised at the Member State level, is urgently needed to set clearer parameters for the current uses and future developments of these technologies and materials. This debate should seek public opinion and views on which developments are considered acceptable or necessary and under which conditions. Even if the outcomes are unfavourable towards some of these technologies, the EU must respond to public opinion accordingly. The European Commission needs to work in collaboration with Member States in organising such a debate at the earliest possible moment.

EEB therefore urges the European Commission and the Member States to immediately undertake an EU-wide public debate on nanotechnologies and nanomaterials. This should form part of a wider debate on technological innovation.

3. Put in place an adequate policy and regulatory framework before further market penetration occurs

Given that there is disagreement over the adequacy of existing legislation to address the potential impacts of nanomaterials, it is clear that the European Commission's regulatory assessment conclusions are not satisfactory and do not provide a solution to closing the regulatory gaps. Experience from REACH (the EU's most comprehensive chemicals legislation) has already shown the limitations of this legislation in dealing with nanomaterials and that current implementing tools (e.g. test methods, communication of test results, etc.) do not apply at the nano level.

Taking the approach of amending existing legislation is already leading to fragmented and incoherent governance, best illustrated with the current revisions of the Novel Foods Regulation and the Cosmetics Directive. Given that nanotechnologies and nanomaterials can be used in many different ways and in different types of products, a policy and regulatory framework, which can address these various applications coherently and comprehensively, is needed. This framework should also be able to address future developments, as detailed in our demand for a pre-market registration and approval framework.

EEB therefore calls for the development of a nano-specific policy and regulatory framework, addressing existing and future applications. In an interim period, case-by-case amendments to legislation will need to continue, especially to more quickly bring nanomaterials into formal legislative mechanisms.

Such a comprehensive and coherent policy and regulatory framework would need the following:

- An immediate review and revision of existing legislation relevant to nanomaterials.
- The urgent and strict application of the REACH 'no data, no market' approach to products containing manufactured nanomaterials that could lead to exposure of consumers or the environment.
- Required pre-market approval for all applications of nanotechnologies and nanomaterials as a central element of the policy and regulatory framework.
- Provide the necessary implementation tools for the coherent and comprehensive management of these technologies and materials. Particular focus and priority is needed on the development of testing methods to identify human health and environmental impacts.
- To develop robust safety assessment standards while recognising the serious limitations of our existing scientific capacity and knowledge to identify potential impacts.

- The Precautionary Principle, the Polluter Pays Principle, and sustainability objectives need to be the basis of the policy and regulatory framework. This would help to guide developments towards more societally beneficial (e.g. solar energy technology) uses than those with questionable benefits (e.g. stain-free fabrics).

- Clarity and coherence on the key aspects of nanomaterials definition, with focus on:
  - Size being defined from 0.3nm to 300nm;
  - Substances having nanomaterial-like properties to be included, even though they fall beyond the official size range;
  - All nanomaterials to be included in regulation, not just those that are insoluble or bioaccumulative, as well as aggregates and agglomerates;

- To immediately start working on the establishment of a mandatory EU label as an identification tool to be placed on products containing manufactured nano-materials, which could lead to exposure of consumers or the uncontrolled release in the environment. Such a label would work on an intermediate basis, before the EU-wide public debate is finalised and a regulatory framework is prepared reflecting the demands of the public on the appropriate identification tools. Public debates should also help to identify what other communication tools are useful to increase and improve public awareness of the issues.

4. Prioritise research funding on the functioning of natural and human systems with respect to possible impacts of nanomaterials on these

Currently, the vast majority of EU nanotechnology research funding focuses primarily on technological development, aimed at enhancing competitiveness and growth. This is unacceptable given the continuing unknowns about nanomaterials and that current product and safety testing does not extend to the nano-level. EEB therefore calls for prioritisation of funding and the majority of research being directed toward environmental and human health aspects and strengthening social innovation on public participation in decision-making.

We therefore call on the European Commission to:

- Prioritise research funding in favour of eliminating knowledge gaps, over increasing funding in technological development. A sliding scale starting around 80 % and reducing over time to around 15 % should be reserved for the environmental, human health and social, economic and ethical implications of nanotechnology. All new projects receiving EU funding should be required to include sustainability assessment, public participation and decision-making mechanisms.

- Clearly identify the limitations of existing safety assessment and management tools in relation to nanomaterials. This should be done in conjunction with the

research on eliminating knowledge gaps on environmental and human health impacts. In this way, the research development priorities can be identified based on the gaps between current tools and the demand for existing and future uses of nanomaterials.

- Develop and implement a research strategy identifying a roadmap for improving knowledge leading to the safer development and use of nanomaterials in different applications.

- Further develop sustainability assessment of technologies tools, for their more systematic use in both research and product development. These should also be used in policy developments on innovation and eco-innovation, and sustainable industrial policy.

1 *"Union policy on the environment shall aim at a high level of protection taking into account the diversity of situations in the various regions of the Union. It shall be based on the precautionary principle and on the principles that preventive action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay. In this context, harmonisation measures answering environmental protection requirements shall include, where appropriate, a safeguard clause allowing Member States to take provisional measures, for non-economic environmental reasons, subject to a procedure of inspection by the Union."*

The EEB position statement is currently playing a role in the deliberations of fora such as the European Parliament, European Commission, OECD and REACH.

The Netherlands

The activities of the Dutch NGO Natuur & Milieu have been strongly oriented towards political lobbying and influencing the policy making process on the Dutch framework for nanotechnology. An intensive lobbying campaign was designed and implemented, targeting parliamentarians, political advisors and policy makers at the Ministry of the Environment and the Ministry of Economic Affairs. Use was made of information obtained during Nano-Cap working conferences so as to make a convincing case for the need to develop sound policies limiting environmental and health risks.

Italy

The Italian Legambiente chose to participate in the debate through the organisation of several public conferences in Milan. Public institutions, industrial associations, trade unions, and researchers discussed Legambiente's position paper as well as legislative initiatives in Europe and Italy. Thanks to these events, all involved gained further information on the

issues around nanotechnologies at the national level and enlarged their networks of stakeholders. Legambiente gathered important elements for the drafting of their position papers on nanotechnologies.

Lithuania

The Baltic Environmental Forum was able to establish their position paper within a coalition of Lithuanian Environmental NGOs, which gave it more power on the national level. Awareness-raising activities are thought to be essential. Given that political debates on nanotechnology have not really started in the three Baltic countries (Estonia, Latvia, and Lithuania), the development of a public debate is essential to move the political situation on. Special attention should be paid to the concepts of sustainable and responsible nanotechnology and what it means in practice to oppose current trends in the development and progress of nanotechnologies. The Baltic states obviously lack experience of how to launch such debates on the ground. Furthermore, small country syndrome (the sense of being small and unable to influence EU developments) is very much alive in Baltic States, and is the main trigger for any (limited) changes.

Greece

The Greek MIO-ECSDE put much effort into the development of educational material to be used by members of the MEDIES network (Mediterranean Educational Initiative for Environment and Sustainability). Awareness-raising activities amongst the Mediterranean MIO-ESCDE members were also organised. A web based interactive application was developed, entitled NanoVirtualium. This was designed as a futuristic virtual reality dome which invites visitors to wander through the world of nanotechnologies. It provides basic and advanced information about these emerging scientific fields and their implications at all levels, including for health, the environment, society and regulation. The information within this will constantly be adapted and updated to take into account developments in nanotechnology and its associated fields.

The public debate

NanoCap's most visible activity was its final conference, which involved the public presentation of the CSO positions – to an audience of more than 200 interested stakeholders – through a liaison with the European Parliament and STOA (Science and Technology Options Assessment). The CSO demands for further nano-regulation were brought forward, and proved to be successful. The dialogue was structured through two panel discussions between representatives from trade unions, environmental NGOs, consumer organisations, employer associations, industry, the European Parliament and the European Commission, as well as involving participation from the diverse audience present.

It was stated that we already know a lot about the hazardous properties of different nanoparticles, as well as about the nanoparticles themselves and the substances from which they are derived. Although we know very little about actual exposures, both in the workplace and

in product chains, we know enough to make the need for a precautionary approach clear. We need to regulate, then, by analogy with those areas where we do have knowledge. REACH is often understood as providing the framework for nano-legislation, but adaptations are needed. Existing loopholes in REACH will have to be closed in the next two years.

The message drawn from the actual development of nanotechnologies is that product development is not going to wait for scientific evidence of safety or harm (which may in fact never become available). A good legal – and preferably binding – framework is needed to manage the possible risks associated with nanotechnology.

Conclusions

TUs and NGOs in the nano-discussion

The conclusion drawn from the project was that NanoCap's capacity building process was successful in supporting trade unions and NGOs to develop positions on nanotechnology. The increase in knowledge gained by the partners did not result in an aversion to nanotechnologies. Instead, trade unions and NGOs were able to develop collective European position statements, sometimes complemented with national refinements. A key role in all these statements was a precautionary approach to the use of nanomaterials.

Worker interests in nanotechnologies

The goal for trade unions is to ensure a safe workplace for all working with nanotechnologies and nanomaterials. Nanotechnologies and manufactured nanomaterials may have considerable potential for the development and application of new products. It is certain that technological improvements will emerge and that new jobs will be created in this field. However, the trade unions' call for transparent and independent risk assessment is essential. The precautionary approach should be applied in cases where data is lacking. In addition, the trade union call for legislation for nanotechnologies should be recognised and complied with.

NGO interests in nanotechnologies

The responsible governance of nanotechnologies and nanomaterials, along with their various applications, is crucial for environmental NGOs. The backbone of such governance is the adoption of a strict regulatory framework, which will ensure the maintenance of environmental and human health while following the principle of sustainability. Furthermore, environmental NGOs demand that the precautionary principle should be employed in the development and use of nanomaterials until there is an adequate EU regulatory framework for the oversight of these.

According to the NGOs the highest priority should be given to consumer products already on the market or in near-market stages. These should be comprehensively assessed as to their effects on human health and the environment without delay. A key challenge is to ensure the setting up of a long term action plan. This should involve engaging all

stakeholders in an open discussion at an early stage in the development of this powerful, innovative, high-end technology, so as to ensure that this development moves towards the resolution of many of the world's current problems without posing new environmental, social, economic or health hazards.

Nanotechnology and a precautionary approach

It has been difficult to identify products manufactured with the use of nanotechnologies and, due to a lack of knowledge, it is also difficult to judge the current benefits of nanotechnologies. Policy instruments must be used to balance the two ends of the scale: *economic value* (potential benefits, the replacement of scarce raw materials, stakeholder interests, new job creation) balanced against *'acceptable' risks* (hazard and exposure assessment, risk behaviour, uncertainties). However, a simple weighing up of the pros and cons is not possible.

Taking the precautionary approach seriously is an essential but difficult task. Accepting precautionary measures (which are perhaps comparable with preventive measures) might be problematic for many companies. Initiatives such as voluntary codes of conduct may be helpful guides, but the view of trade unions and NGOs is that these types of voluntary systems cannot replace binding legislation.

Building blocks for a precautionary nano approach

A starting point for the trade unions and NGOs involved in NanoCap is the development of the precautionary approach in such a way as to be practically relevant to industrial practice. It has been emphasised that the REACH principle 'no data → no market' can be adapted as 'no data → no exposure', so as to function as an acceptable starting point for risk management measures around nanoparticles with limited hazard data. To achieve transparency on the composition of nanoproducts, manufacturers and suppliers must be obliged to disclose the type and amount of nanoparticles and nanomaterials used in their products. This would enable the users of such products to make reliable risk assessments (through the declaration of the type and amount of nanoparticles within the product to an independent body, and the declaration of the nano-content of products throughout the production chain). In this respect, Material Safety Data Sheets (MSDS) can be used to enable transparent risk communication. The MSDS should supply information on known nano-risks and how to manage these, as well as information on existing knowledge gaps. Additionally, there is a call to provide a Chemical Safety Report (in the context of REACH) for substances on the market at lower tonnages (less than one tonne per year per company).

Registration of exposure should be obligatory in the workplace. This could be based on either the registration process for carcinogenic substances or that for reprotoxic substances. Nano-OELs (occupational exposure limits) should be derived, and for those nano-substances where hazard data is lacking, a worst-case approach should be applied by deriving nano reference values [6] using well-considered safety factors, as proposed by NIOSH (National Institute of Occupational Safety & Health). A hazards ranking system for nanoparticles could also be established, as proposed by the British Standards Institute. [7]

At the same time, workers who are potentially exposed to nanomaterials should be regularly monitored in order to identify any adverse effects as early as possible (a form of early warning system). These building blocks can be summarised as follows:

Building blocks for a precautionary nano approach
• No data → no exposure
• Notification of nano product composition by manufacturers and suppliers - Declaration of type and amount of nanoparticles in the product to an independent body - Declaration of the nano-content of the product through the production chain
• Exposure registration for the workplace - Analogue to carcinogen registration for nano-fibres and CMRS (Carcinogenic, Mutagenic, Reproduction toxic and Sensibilizing) nanomaterials - Analogue to reprotox registration for other non-soluble nanomaterials
• Transparent risk communication - Information on MSDS on known nano-risks, management and knowledge gaps - Demand a Chemical Safety Report (REACH) for substances >1 ton/year/company
• Derivation of nano-OELs, nano reference values for frequently used nanoparticles: - fullerenes, SMCNT, MWCNT, Carbon Black, nano- polystyrene and dendrimers - Ag, Fe, TiO_2, CeO_2, ZnO, (amorphous) SiO_2, alumina, nanoclay
• Development of an early warning system
• Measures to avoid marketing of 'nonsense' products

Measures to avoid the marketing of 'nonsense' products

Although it is almost impossible to define clear and unambiguous criteria for what type of products should be classified as 'nonsense products', it is clear for all CSOs that products should not be brought onto the market if they introduce new or uncertain risks to health or the environment while their claimed benefits cannot be substantiated.

Lessons from NanoCap

This paper reflects on how a deliberative approach was adopted for the NanoCap project. This experience can be instructive for organising public debates more generally on the development of nanotechnologies and on their implications for society. The general objective of the NanoCap project was to enable the structured enhancement of stakeholder capacities to understand and critically assess nanotechnologies. More concretely, the aim of NanoCap was to assist trade unions and environmental NGOs in developing positions on nanotechnologies and in taking part in the public debate.

6 See: SER (2009) Social Economic Council, Advisory Report 09/01, 'Nanoparticles at the Workplace: Health and Safety Precautions'.

7 As proposed by the British Standards Institute (2007), in 'Nanotechnologies – Part 2: Guide to safe handling and disposal of manufactured nanomaterials', PD 6699-2:2007.

The open discussion with NanoCap partners, the project design, and its performance have all contributed to the successful delineation of common goals and to an interactive and cooperative process. However, in this process the individual interests of project partners were respected. All involved were free to develop their own action plans, set their own priorities and develop their own positions. This may have contributed to finding a balance between commitment and taking responsibility for the elaboration of work plans. Of course, reporting on progress and exchanging ideas in the project team meetings enabled the harmonisation of joint activities and project results. It is possible that the fact that (potential) differences in interests were limited and that partners entered the mutual learning process from very basic competency levels was beneficial. Another supporting factor may have been that the university partners (who were not considered as representing their universities in the debates) were not forced to take up positions in the debate, and so contributed their expertise in a manner dictated only by academic freedom (though they were not necessarily always neutral or objective). The process was reinforced by confrontation and discussion with external stakeholders, such as industry, consumer organisations and policy makers, which resulted in additional instructive inputs.

European Commission

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